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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION

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Forthcoming Events.

Institution of British Foundrymen.

East Midland Branch.—"Foundry Facings," by H. Winterton, on January 28, 1922, at Loughborough.

Coventry Branch.—"Foundry Training," by T. Vickers, on January 11, 1922.

London and District Branch.—"Industrial Training for Foundry Workers," by T. Vickers, on January 12, 1922.

Introspective—1922.

It is impossible to forecast the prospects of the iron foundry trade as a whole, because it is dependent on so many industries. A boom in textiles would materially affect many Yorkshire and Lancashire foundries, but would be without influence on the North-East Coast foundries. Again, the revival of the automobile industry would give work for many thousands of moulders in the Midlands, and a forward movement in the building trades would keep many Scotch and Midland foundries fully occupied. In addition to all this comes the three main branches of engineering—civil, mechanical and electrical—all of which contribute their quota of work to the iron foundries. It can be safely asserted that some of these trades will go ahead during this year to such an extent that they may provide work in such quantity as to form an overflow from the foundries normally coping for these particular trades. Thus, openings will be made for those foundries who are equipped with adequate plant and technical acumen to carry on until such times as the trades for which they normally cater become reasonably busy. Whilst some foundries may expect a fairly lean time, others may anticipate a good year, and the foundries able to cater for many diverse products should be able to keep going until good times become general. During the year some half-dozen large important foundries will come into existence. These should provide some work for the foundry equipment manufacturers. The new firms will have the advantages of modern plant and equipment, associated with the disadvantages of having had to bring in more capital than their older established competitors, resulting in higher overhead charges. It will be interesting to see whether modern methods under these conditions will be self-supporting. Should trade become really good we have no doubt that the extra output obtainable from modern foundries will be more than able to carry its heavier overhead charges.

This year opens with an international financial conference for the restoration of European trade. Whilst it is too much to hope that it will be able to stabilise the foreign exchanges, it may, by the granting of suitable credits, do much to neutralise the present disabilities consequent on serious daily changes in various currencies.

Much is hoped for from the International Foundry Exhibition to be held in Birmingham during the summer. That a stimulus is needed in the metallurgical industries of this country is evidenced by the fact that only about 90 blast furnaces out of the 480 are at present working. However, here and there are signs of improving trade. For instance, one foundry in the Midlands reports that they have sufficient orders to last two years at their present rate of output. In the malleable castings trade a better output can be anticipated both as regards quality and quantity. This product is receiving attention from the British Cast Iron Research Association, and once a reliable material can be universally produced, instead of as at present by a handful of firms, its sphere of utility will become wider.

For heavy steel castings the outlook is dependent on shipbuilding and general engineering, both of which appear to be better placed than for some months past. The light steel castings trade is usually associated with automobile industry, and this, too, is thought to have reached its lowest ebb.

Amongst the most important factors for good trade is the absence of industrial wages disputes, and here, again, a better feeling is prevalent.

In short, whilst only a universal trade boom can fill all foundries, there is good reason for supposing that some of their contributory industries will be reasonably employed throughout the year, and for these foundries substantial progress should be shown.

Chemistry of Chilled Castings.

PROF. BERNHARD OSANN, in the latest edition of his treatise on Iron and Steel Foundry Practice, publishes a table showing the chemical analysis of nearly a score of chilled castings, which we reproduce herewith. No. 19 has been added from the test. Castings Nos. 15 and 16 (calender rolls) contained also 0.07 Cr. The following is a detailed description of the castings:—

(1) Chilled roll cast in Krupp's Gruson Works.
(2) Chilled roll 500 mm. (19.7 in.) in diameter.
(3) Chilled roll 550 mm. (21.6 in.) in diameter.
(4) Chilled roll 200 mm. (11.8 in.) in diameter.
(5) Chilled roll (English make) for rolling thin sheets.
(6) Chilled roll (German make) for same purpose.
(7) Chilled roll (German make) for same purpose.
(8) Siegerland roll for rolling thin sheets. Diameter, 680 mm. (26.0 in.); length, 1,650 mm. (65 in.); specified depth of chill, 15 to 30 mm. ($\frac{5}{8}$ to $1\frac{1}{8}$ in.), cast with metal from furnace.
(9) General requirements for chilled castings. (Tensile strength, 42 kg. (26.67 tons per sq. in.). with area 50 sq. mm. (0.07 sq. in.).
(10) American railway car wheel.
(11) American railway car wheel.
(12) Chilled armour plate (Gruson Works).
(13) Chilled roll from Westphalia.
(14) American chilled roll.
(15) Roll for calendering indiarubber sheets. Diameter, 550 mm. (22 in.); length of roll, 1,500 mm. (59 in.); depth of chill along roll, 40 to 42 mm. ($1\frac{1}{2}$ to $1\frac{2}{3}$). The roll took a very high polish.
(16) Roll for calendering paper. Diameter, 500 mm. (19.6 in.); length, 2,750 mm. (108 in.); depth of chill along roll, 40-45 mm. ($1\frac{1}{2}$ to $1\frac{3}{4}$ in.). This roll also took a very high polish.
(17) Hot roll for rolling thin sheets. Depth of chill, 20 to 30 mm. ($\frac{3}{4}$ to 1 1-5 in.); this roll gave good results. For cold rolls the depth of chill must be 10 mm. (0.40 in.) more. A roll with 2.05 per cent. Mn. and 0.15 per cent. S. content broke.
(18) Stone-crusher jaw according to Palmer's Foundry Practice.
(19) Rolls for crushers in sugar mill. Suitable analysis for metal melted in furnace. If dealt with in a cupola about 40 per cent. of steel scrap must be used, and the remaining 60 per cent. of the charge must be comparatively low in carbon.

	C. %	Si. %	Mn. %	S. %	P. %	Cu. %
1.	3.82	0.74	1.34	—	0.44	—
2.	3.85	0.69	—	0.08	0.50	—
3.	3.50	0.65	—	0.08	0.45	—
4.	3.45	0.72	—	0.02	0.58	—
5.	2.79	0.74	0.42	0.13	0.58	—
6.	3.10	0.45	0.55	—	—	—
7.	3.42	0.53	0.46	0.13	0.53	0.135
8.	2.70	0.67	0.62	0.08	0.29	—
9.	3.70	0.5–0.65	0.7–1.1	0.10	0.50	0.10
10.	3.47	0.86	0.49	0.127	0.35	—
11.	3.20	0.67	0.52	0.106	0.26	—
12.	3.03	0.70	1.10	—	0.42	—
13.	3.50	0.54	0.47	—	—	—
14.	3.00	0.71	0.39	0.058	0.54	—
15.	3.70	0.67	1.60	0. 35	.51	0.022
16.	3.75	0.65	1.54	0.035	0.50	0.035
17.	3.25	0.67	0.76	0.08	0.26	—
18.	—	0.8–1.0	0.8–1.2	0.08–0.1	0.2–0.4	—
19.	2.75	2.04	0.57	0.055	0.95	—

Prof. Osann considers the manganese content of the two calender rolls (1.60 and 1.54 per cent.) too high. In the case of chilled rolls for sheet mills, where very great strength and a hard surface are required (especially in the case of hot rolls), the manganese should be kept down as low as possible. When less strength is required, 1.1 per cent. Mn., or perhaps more, may be permissible. The two American railway car wheels (Nos. 10 and 11), which had to satisfy rigid requirements, and some of the rolls for sheet mills in the table seem to bear out the precaution as to low manganese. The thickness of the castings and the diameter in the case of rolls must, of course, be taken into consideration. It is advisable to start with a given manganese content and adjust the silicon percentage accordingly.

In the case of massive castings and a great thickness of metal there may be a difficulty in finding a pig-iron of sufficiently low silicon content. In such an emergency the manganese content must necessarily be raised, but not too much. A percentage of 1.1 may perhaps be too high. The depth of the chill being as a rule specified, the influence of the diameter and of the thickness of the metal must be determined by trial. For castings with great thickness of metal the silicon must be kept low and the manganese content raised accordingly. The author generally uses a Siegerland brand of pig-iron, with about 1.1 per cent. manganese and 0.5 per cent. silicon. Should a preliminary trial prove that the chill is not sufficiently deep, 1.5 per cent. of this pig-iron (or in the case of small diameters or hollow rolls 1 per cent.) is added for every mm. deficiency in the depth of the chill.

It is easy to get the proper depth of chill, but more difficult to get the required surface hardness. In order to obtain this, charcoal pig-iron must be used, the minimum quantity being 30 per cent. American car wheels are cast from a mixture of charcoal pig-iron and broken wheels, the rest of the charge not exceeding 15 to 20 per cent. A foundryman experienced in chilled castings can tell by the fracture whether the percentage of charcoal pig is too low or excessive. In the former case the fracture will show a coarse grain and the graphite appear in pockets in the castings.

The author's advice is that when using broken rolls as scrap these should be sorted out according to the depth of the chill (5, 10, 20, 30, 40 and 50 mm.). By remelting this scrap without additions the depth of chill is always reduced, generally by one-half when the original depth was 25 to 30 mm. It will be necessary, therefore, to add pig-iron higher in manganese, as a portion of the manganese is always lost in re-melting in the cupola (25 to 30 per cent. of it), while the loss in silicon is comparatively small, amounting only to a few per cents.

The British Cast Iron Research Association.

The Bureau of Technical Information.

The Technical Bureau has now been organised at the offices of the Association for the use of members.

The object of the Bureau is to supply members with any technical information or data upon foundry work they may require.

The Bureau receives every week all the world's technical journals wherein any data incidental to foundry work is published. This data is translated, abstracted, and indexed, and will be issued in bulletin form to the members.

All the foundry technical literature, patents, improvements in plant, etc., are received, classified and catalogued.

The Bureau is daily collecting information and data upon the best foundry practice for the use of members.

The library contains a large number of technical books, and it is intended to form a complete collection of all technical literature that will be useful to the foundry industry. These books can be borrowed by members.

Members are asked to apply to the Bureau for any technical information or data they require or any abstracts or copies of papers. Members should consider the Bureau as the reference library of their own works. It can then be of immense use to them.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Doelcam Sand Blast Table.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Relative to the article on sand blast plant in the December 15 issue of THE FOUNDRY TRADE JOURNAL, may we ask you to kindly state that these sanitary table equipments may be had in various sizes and capacities to meet special requirements.

It might be assumed from the description in question that only the 7-ft. table equipment is manufactured by us.—Yours, etc.,

RONALD TRIST & CO., LTD.,
Dinneford House, E. L. SAMSON.
12, Clipstone Street, W.1.
December 21, 1921.

Control in a Railway Iron and Steel Foundry.*

By G. N. Shawcross, M.B.E., M.I.Mech.E.

The chief point of importance in a modern works is the advance of the foundry, and locomotive works are not behind in this respect. Formerly it was the custom to tolerate the foundry as a necessary evil in comparison with other shops, and to relegate it to a corner in the works. But the advent of the metallurgical engineer, of the moulding machine and the air compressor with its accompanying pneumatic tools have changed the one-time contempt into real interest, and it is now realised that cleanliness and system, lofty, well-lighted buildings and overhead travelling cranes are just as much part and parcel of a modern foundry as of an erecting shop; and, further, that the money wisely spent on the initial start of a casting is amply justified by the returns due to less labour in the machine and assembling departments at a later stage. Frequent foundry references and really useful articles of late by technical and trade journals mark the same advance, and no engineer can afford to disregard how his castings are made.

Co-operation of Chemist and Moulder Necessary.

The subject of control exercised in a foundry covers a wide field, entailing a first-hand knowledge of matters psychological, mechanical, and metallurgical. Whether the production of castings is an art or a science is hardly for this paper to debate, but certainly the human side bulks largely. The moulder is the main factor in producing a casting successfully; his craftsmanship lies in the application of scientific principles, and it is not fully realised that any applied science in the foundry must have the help of the moulder.

Methods of placing the technical side within reach of the foundry craftsmen are shortly indicated at the end of the Paper.

It is proposed to outline examples of the control of men, methods, and materials in the well-known locomotive works of the Lancashire and Yorkshire Railway, at Horwich, by showing what output is produced and by what methods it is turned out; manufacturing system is not referred to in the scope of this Paper beyond the fact that piece-work is adopted throughout.

Type of Output.

This foundry produces castings of all descriptions, including railway chairs, iron and steel castings, malleable iron castings, and, lastly, steel ingots, the whole amounting to over 30,000 tons per annum as follows when fully employed:—

	Tons.
Iron castings	6,904
Cast iron chairs	8,730
Malleable castings	146
Tropenas steel castings	2,512
Siemens acid steel ingots	12,942
Total	31,234

FIG. 1.—GENERAL VIEW OF THE FOUNDRY AT THE LANCASHIRE AND YORKSHIRE RAILWAY WORKS AT HORWICH.

Such an output, valued at prices ruling in October, 1921, is worth approximately £500,000. It is made in a shop 486 ft. by 111 ft. with six cupolas and two Siemens-Martin furnaces, one Tropenas converter located on the outside of Fig. 1; but the steel castings are annealed, fettled and dressed in an adjoining shop 138 ft. by 43 ft., the malleable castings being similarly treated in an adjoining space 30 ft. by 43 ft. To produce such an output in a limited area calls for labour-aiding contrivances of many kinds, together with a plant run on a sound technical basis.

No other foundry in Great Britain produces the varied output above; the fact that this is done within the four walls of one shop gives considerable value to the Paper in its description of output and equipment.

Pre-War and Post-War Output.

By permission of Mr. George Hughes, C.B.E., chief mechanical engineer of the Lancashire and Yorkshire Railway, the author is enabled to show the workings of this foundry over which he is in charge as foundry and steel works manager.

Comparative figures of output show that in the iron foundry for half-yearly periods of June, 1914, and December, 1920, 88.02 and 80.43 man-hours respectively were required to make a ton of iron castings, but counting only specialised labour and

* A Lecture recently read before the Cambridge University Engineering Society.

apprentices these figures read 44.9 and 40.37. It should be stated that in the interval the output had risen from 2,946 to 3,249.

In the steel foundry, for the pre-war periods, counting all, 129.67 man-hours were required to make a ton of steel castings, but based on tradesmen and apprentices only 35.49. Since the war the corresponding figures read 130.7 and 32.63. Here output increased from 712 to 746 tons.

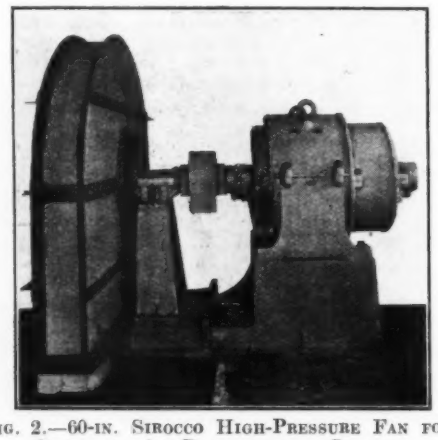


FIG. 2.—60-IN. SIROCCO HIGH-PRESSURE FAN FOR SUPPLYING AIR-BLAST TO THE CUPOLAS.

TABLE I.—*Total Man-Hours Per Ton of Castings.*

Foundry No.	Type of Casting.	Per worker per 53 hrs. in 1914.	Per worker per 47 hrs. in 1919.
1.	General Millwrights and heavy castings.	—	260.0
2.	Heavy engineering castings, 50 per cent dry sand moulds.	220.2	221.7
3.	Large engineering castings, 50 per cent dry sand moulds.	173.9	208.9
4.	Tested boiler fittings, 50 per cent. M/C	124.4	147.8
5.	Textile castings-day work.	117.0	146.0
6.	M/c tool castings on day work.	111.6	140.0
7.	Textile machines.	92.2	140.0
8.	Jobbing work for M/c tools machine moulding introduced.	151.4	94.0
9.	Gen. casts 90 per cent. plate patterns.	—	78.3
10.	Railway wagon axle-boxes, brake blocks, 80 per cent. M/c	—	45.0

Valuable comparisons can thus be made, the pre-war period comprising a working week of 53 hours with two daily stops for meals as against the post-war period of 47 hours with one meal hour daily. In both periods the foundry space and main equipment were exactly the same. The additional work caused by the conversion of molten iron into steel in the converter and the fettling of the tougher steel castings account for the greater number of hours for steel as against iron, after the factor of more repetition work in iron castings has been discounted.

Total hours and not the moulder-hours are stated on account of the uncertainty in the latter as to who is included, effect of boys, coremakers, etc. Foundry output is produced by foundry workers, the storekeeper and pattern attendant contributing to the whole when efficiently controlled. Also, the total hours per ton are more readily comparble with other places when the ratio of hand to machine and plate moulding is known. A foundry moulding general millwright work cannot specialise like one on textile fittings or railway chairs where thousands of castings are repeated.

In recent years the unstable conditions of rates of wages and shorter hours make comparisons with pre-war records difficult, and foundry managers find that costs per ton are not nearly so illuminating as hours per ton, which it is submitted will be a standard of the future.

Probably no iron castings lend themselves to larger outputs and consequently to less hours of labour to produce than cast-iron chairs. In this manufacture a large output may amount to 1,000 tons per week which, consisting as they do of only a few varying patterns, may show so low a figure as eight hours of labour to turn out one ton of castings.

The figure at Horwich for 200 tons weekly output is 9 to 10 hours per ton; a moulder and top rammer making 300 chairs per day. Such figures are not comparable with those for a general iron foundry, and only show what can be accomplished in specialised cases.

Data has been collected from a number of general iron foundries, and Table I. tabulates figures of pre-war and post-war practice which only too graphically tell their own tale, namely, that the shorter working week now in vogue together with post-war temperament of human nature make serious problems for which the British foundry manager has to cope.

Efficient management in supply services and methods of control in materials are essential, but largest of all is that part in the manufacturing system which every worker must exert for his own team and his own country.

Castings are made in the following proportions :—

Iron Castings.	Per cent.
Hand moulding, chimney cylinders superheater headers	45
Plate moulding, brake-blocks, and general	31
Machine moulding, C. and W. axle-boxes, firebars, brake-blocks, and general	24

Steel Castings.	Per cent.
Hand moulding	50
Plate moulding	12
Machine moulding, wheel centres, motion plates	38

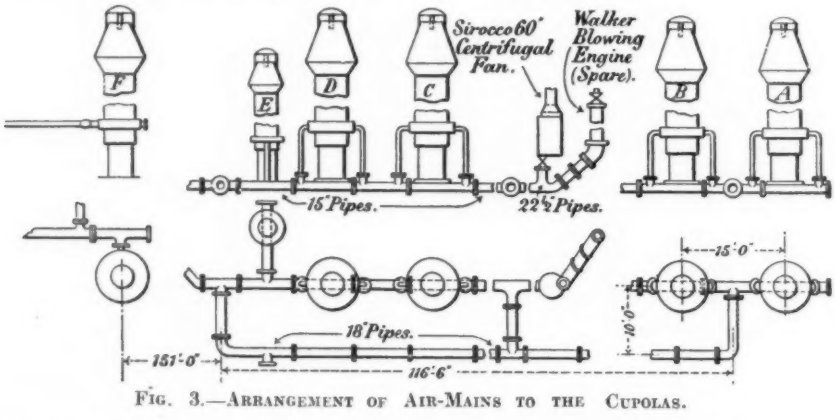


FIG. 3.—ARRANGEMENT OF AIR-MAINS TO THE CUPOLAS.

Chair Castings.	Per cent.
Plate moulding for sand and chilled castings and cores	100

A foundry engaged upon locomotive work and its accessories has to some extent an opportunity of specialising its equipment for certain classes of work which are standard parts. Though types of engines may differ, there are many instances worth noting where repetition work enables quick production to be achieved by the use of moulding machines or plate moulding. Twenty-six moulding machines are in use for sand and chilled castings and cores. Various mechanical devices contrived to meet some local requirement or minimise laborious work—as, for instance, a hydraulic bucket lift to cupola, turntables for moulding machines, 55 ft. jib crane and magnetic tup for scrap breaking, gyratory riddles, etc.

Services of Power.—Power is available in the form of:—Electrical energy, producer gas, compressed air, air blast, steam, hydraulic pressure, town's water, and waste heat and exhaust steam. All these are utilised, and need control to avoid waste. Table II. indicates the form thus taken and the instruments in use. Card records of repairs to compressors, fans and motors are necessary, whilst for automatic recording pressures of steam and air the Simmance recorder is simple and requires little attention.

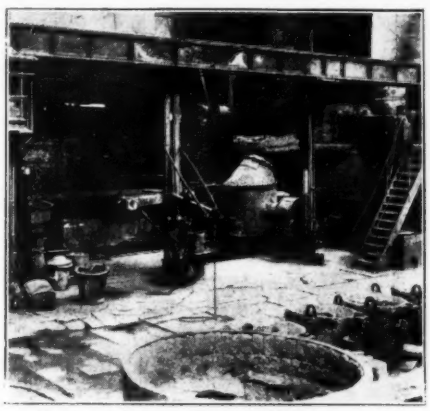


FIG. 4.—THE TROPENAS PLANT AT THE HORWICH WORKS.

Waste heat from heating furnaces is harnessed to dry cores, and exhaust steam is similarly treated for blast saturation at the gas producers.

Air Compressors.

Compressed air at 80 lbs. pressure is supplied by an Alley and MacLellan "Sentinel" air compressor giving an output of 200 cub. ft. of free air per minute at 276 r.p.m. and 250 cub. ft. at 346 r.p.m.; when running at the latter speed, the motor power required is 50 h.p.

The compressor is direct-coupled to a 50-h.p. B.T.H. motor in place of being gear-driven, thereby saving a considerable amount of power without any upkeep charges in the way of replacement pinions and gear wheels, and the noise of running is practically eliminated. It is used for working the Mumford and Tabor jar-moulding machines, air hoists for auxiliary lifts, fettlers, chipping hammers, cleaning of moulds and core blacking.

Pneumatic hammers are indispensable; without them the area for fettling would require enlarging considerably. The steel fettling shop is equipped with fourteen No. IX. size Keller hammers, which are in constant use by all the dressers for cleaning sand and cutting fins off castings.

This hammer, which has a stroke of 1½ in. and a piston diameter of 1¼ in., is fitted with one cylinder, and gives 3,000 blows per minute. It weighs 12 lbs., and had an air consumption of 20 cub. ft. of air per minute when working continuously for one minute.

Taking into account the time taken in lifting a casting on the bench, fixing and putting same down again after dressing, sharpening of chisels, etc., also that where a number of hammers are working they never actually strike together but work intermittently, the total air consumption may be taken at 40 per cent. of the possible total, or 112 cub ft. for the fourteen hammers, thus a compressor capable of compressing 112 cub. ft. per minute will supply the hammers with air satisfactory under general working conditions. Sand blasting for cleaning castings is not used.

TABLE II.—*Outlining the Services Controlled by the Laboratory.*

	Control.	Record.
Compressed air. 80 lbs.	Methods at Driving, repairs and upkeep of spare parts one steam and one electric compressor.	Simmance continuous tape chart instrument. Budenburg gauges for indicating pressure are fixed at various parts of the air main.
Blast air. 25 in. W.G.	Bristol's recording gauge and mercury column.	
Steam. 80 lbs.	Simmance continuous tape chart instrument.	Simmance tape chart record. Allocation for each department made out every half year.
Producer gas.	Orsat gas sampling apparatus to determine CO, H, C, H_2, CO_2, N, O, constituents in the gas. U-tube used for fan air pressure. Whipple Temperature Indicator for temperature of gases passing through the flue. Weekly records taken for temperatures, leaky valves, etc., with Whipple Temperature Indicators. Cambridge Single Thread Chart Instrument is used on the Melting Furnace chimney stack.	
Hydraulic pressure 1,000 lbs.	Gauge and cut off mechanism.	
Furnace Temperature (Pyrometry)	Platinum Rhodium Thermo Couple Pyrometers are attached to each furnace where annealing is done. Temperature is recorded by Thread Chart instruments and Wall type indicators, made by the Cambridge Instrument Company.	Card records are kept of all repairs, and duration of stoppages for each motor.
Electric Current	Elliot Recording Ammeter is periodically put in motor circuits so that no motor can be overloaded without the fact being known.	

TABLE III.—*Showing the Materials Controlled by the Laboratory.*

Coal and coke.	Each consignment entering the works is sampled and sent to the department requiring the specified class of fuel.	Approximate analyses of coal and coke are taken to determine volatile matter, fixed carbon, sulphur, ash, moisture and B.T.U
	Cupola tests.	To British Standard Specifications No. 24, 1921.
Tropenas and Siemens Martin Steel.	Tested for tensile and bend tests. Cast-iron tensile and transverse tests. (Micro structure and analysis.)	
	A small sample from every heat of metal cast is sent for analysis.	Eggertz Process for carbon and manganese done on melter stage, full analysis at the Laboratory.

Sands and Refractories—mixtures and tests.
Alloys and Oils—Laboratory Analysis.

Cupolas.

Fig. 2 shows the 60-in. Sirocco high-pressure fan supplying air blast to the cupolas, and Fig. 3 gives the air pipe line. Of these cupolas, A or B and C or D (Fig. 3) are worked daily; E works daily on malleable for four hours, and F works two days per week. Four cupolas are thus run two days per week.

This fan was installed in 1912 when the makers, Messrs. Davidson, of Belfast, described it as their largest fan. It supplanted a steam-driven three-cylinder blower and a No. 4 Roots' steam blower, both of which have been retained as possible reserves though seldom used, the latter being called upon in case a single cupola only is wanted to work. A second No. 4 Roots blower to drive cupola "F" has been dispensed with

At the time of installation there were some doubts as to whether a high-pressure fan would alone do all the work, but nine years' service has proved it to be satisfactory in every way, saving both power and upkeep costs.

The only initial trouble was a slight "surging" effect of blast pressure at 26-in. w.p., which was overcome by placing a cast-iron pressure chamber 3 ft. 6 in. by 7 ft. deep in the pipe line under the fan and by adjusting the position of the motor brushes 1½-in. out of their original position on the commutator.

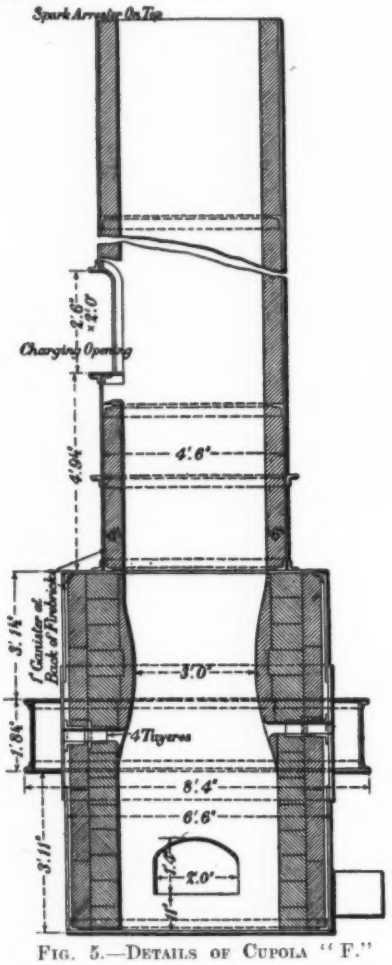


FIG. 5.—DETAILS OF CUPOLA "F."

A day's run of the fan is appended, and the specification to which the order was placed was:—60-in. Sirocco high-pressure fan direct-coupled to one 120 b.h.p. shunt wound variable speed motor with commutating poles by the British Westinghouse Company, to run at 800-1,150 r.p.m. with 250-volt c.c., including protected type, starting and speed regulating panels, main switches and fuses, starter and regulator. Temperature rise of motor not to exceed 85 deg. Fah. The guarantee was to melt 17 tons of iron per hour for a consecutive period of eight hours in any of the cupolas shown in Fig. 3.

TABLE IV.—*Record of 4 Cupolas Driven by 120 H.P. Sirocco Fan.*

Cupola.	Internal Diam. ft.	in.	Tons Melted.
A.	3	6	58.0
C.	3	6	43.0
E.	2	6	1.15
F.	3	0	48.0*

* This is an equivalent figure as F melts 50 per cent. hematite pig and 50 per cent. steel scrap.

Total Iron melted by Fan when worked 9 hrs. 45 mins equals 150 tons 3 cwt. less 2 tons melted by the steam blower in meal hour.

Average amount of metal melted per hour	=	15 tons.
,, ,, current used ..	=	208.8 amps.
,, voltage	=	250
,, amount air pressure ..	=	25.2" water.
,, speed of fan	=	1012 r.p.m.
Maximum H.P. developed		84 h.p.
Minimum H.P. developed ..		53.5 h.p.

NOTE.—Cupola F. was blown in meal hour by steam blower, whilst furnaces A.C.E. had their valves shut.

Locomotive Cylinders.

The production of locomotive cylinders calls for great skill. If cast-iron firebars and brake-blocks represent the cheaper quality of railway foundry work, certainly cylinders with twin barrels, intricate cores for steam valves and passages and shaped to form a saddle for loco. boilers are an example of the highest class of work. They require to be machined practically all over, bored, planed, drilled and tapped, without showing the defects of porosity, cracks or shortness of metal; and, lastly, they must conform to standard tests.

There is a requisite composition of pig-iron and scrap to blend, in order to produce a casting to which tensile and transverse tests may be applied. These cylinders have twin barrels of 18 in. dia. with circular piston valve chambers, and weigh 2¼ tons each. They are cast of the following mixture:—6 cwts. Warner CB. No. 5, 7 cwts. Goldendale No. 6, 2 cwts. Eglinton No. 3, and 5 cwts. scrap cylinders

A vertically cast test-bar 2 in. by 1 in. by 36 in. is made with each cylinder, and is cast just before the casting itself. The test figures on twelve consecutive casts showed that the tensile test ranged from 15.1 to 18.9 tons per sq. in.; the transverse test from 1.42 tons to 1.99, associated with deflections of from 0.27 to 0.40 ins.; the Brinell hardness figure varied from 201 to 223. The chemical composition of the bars varied as follows:—Cc. 0.54 to 0.69, Gr 2.76 to 3.20, Si 1.60 to 2.10, S 0.146 to 0.19, P 0.45 to 0.812, and Mn 0.55 to 0.72. This represents standard Lancashire and Yorkshire Railway foundry practice, and gives a tough, close-grained casting with good machining surfaces.

Steel Foundry.

The introduction of the small converter has opened out a wide field, which may briefly be said to be in the manufacture of castings of any weight, from a few pounds up to 2 tons, and may include light sections even bordering on ornamental design. Whilst the open-hearth processes will also deal with light castings and range up to 10 tons or more, there is not the same elasticity in the making of smaller castings, particularly in the softer grades, and weighing less than 1 cwt., which is a feature of the small converter. Open-hearth plants to work economically must, operate continuously: heats of metal must be tapped and dealt with both day and night. Where steel ingots are required these, of course, can be made during the night. But for the usual steel foundry these conditions do not hold. Ingots are probably seldom required, and only one heat per day will be got out, thus entailing serious waste of heat in the furnace, which is only working at half its duty.

The Tropenas Plant.

An ordinary day's work of 11 hours 13 minutes with a side-blown 2-ton converter shows a yield of molten metal for castings of 22 tons, 16 cwts. Allowing alternate days for preparation of moulds and necessary repairs, three such days may be taken as the weekly output.

The plant consisting of cupola, converter and air blower to give 4 lb. sq. is shown in Fig. 4.

When not blowing the plant is shut off and no heat losses accrue for stand by time beyond preliminary heating up of converter by coke and blast for a few hours prior to starting up.

Composition of Raw Materials.—The pigs used were E.N. Nos. 1 and 2 mixed hematite and Carnforth No. 7 containing Cc. 0.15, Gr. 4.32, Si 4.20, S 0.033, P 0.044 and Mn 1.60 per cent., and Cc. 0.44, Gr 3. 2, Si 1.64, S 0.026, P 0.025 and Mn 0.90 per cent. respectively. The average sulphur phosphorus content of the steel scrap was 0.056 and 0.039.

Eleven charges were made, the first two being composed of 50 per cent. E N 1 and 2, 10 per cent. Carnforth No. 1 and 40 steel scrap, whilst all other were mixed in the proportion of 30:30:40 of the above materials. The cupola metal varied between the following figures:—Cc 0.45 to 0.64, Gr 2.76 to 3.16, Si 1.49 to 2.52, S 0.088 to 0.107, P 0.041 to 0.051, and Mn 0.56 to 0.90 per cent. The extreme variations in the finished steel were C 0.12 to 0.28, Si 0.11 to 0.36, S 0.056 to 0.078, P 0.045 to 0.065, and Mn 0.73 to 1.10.

present in the product over the electric furnace. The sulphur limit set by British standard specification No. 24 of 1921 for steel castings is not exceeding 0.07 per cent. This is satisfactory in use, and thousands of railway wheel centres, loco. and motor castings have been made to this specification. Silica brick linings last 1,000 blows before re-lining, the converter being patched with ganister after each day's working.

Cupola Design.—The design of the cupola, Fig. 5, for melting charges of 50 per cent. hema-

FIG. 6.—SOME OF THE MOULDING MACHINE EQUIPMENT USED IN THE HORWICH FOUNDRY.

The duration of blowing was between 20 and 45 minutes for each cast, the air pressure being 3½ lbs. The cupola blast pressure was 21 to 22 in. of water.

Four specimens of the steel were tested, and gave results which much more than satisfied the British standard specification of 26.0 tons tensile, minimum, asscciated with 15.0 per cent. elongation and 90 degs. unbroken bend test.

tite pig and 50 per cent. steel scrap is worthy of more than passing attention.

Losses in Working.

The actual loss of metal up to the time of casting is 23.4 per cent. This is made up 7¼ per cent. in the cupola and 16.9 per cent. in the converter, the latter comprising 6.5 per cent. loss by combustion of the C, Si, and Mn,

TABLE V.—*Giving Particulars of Heats from No. 2 Melting Furnace. November 18th to November 25th inclusive* (1920).

Date charged.	Total Time.	Class of Steel.	Analysis.				
			C.	Si.	S.	P.	Mn.
Thursday Afternoon, Nov. 18th	7¼	Spring	0.60	0.07	0.05	0.05	0.59
„ Night „ „	8½	Mild	0.19	0.06	0.05	0.05	0.57
Friday Morning „ 19th	9	„	0.18	0.06	0.05	0.05	0.64
„ Afternoon „ „	8½	„	0.19	0.06	0.04	0.05	0.60
Sunday Night „ 21st	9	Tyres	0.59	0.25	0.04	0.05	0.81
Monday Morning „ 22nd	8½	„	0.60	0.29	0.04	0.06	0.78
„ Afternoon „ „	8½	„	0.59	0.26	0.04	0.05	0.77
„ Night „ „	8¼	„	0.61	0.26	0.05	0.05	0.79
Tuesday Morning „ 23rd	8½	„	0.60	0.26	0.05	0.05	0.85
„ Afternoon „ „	10	„	0.60	0.26	0.05	0.05	0.85
Wednesday Morning „ 24th	8¼	„	0.64	0.26	0.05	0.05	0.85
„ Afternoon „ „	9	„	0.65	0.26	0.04	0.05	0.80
Thursday Morning „ 25th	8¾	„	0.63	0.26	0.04	0.05	0.85
„ „ „ „	9¾	„	0.59	0.25	0.04	0.05	0.85

Total number of Heats = 14. Yield = 301 tons.
Total coal consumed = 85 tons or 5.65 cwts. per ton of Output.

The total weight, including alloys charged, was 29 tons 15 cwt. 2 qrs. 5 lbs., and this yielded 22 tons 16 cwts. Some 3 cwt. 2 qrs. 4 lbs. of coke and 16 lbs of limestone were used per ton of metal melted. The sulphur in the coke was 0.775 per cent.

The main drawback to the process being the melting of pig and scrap steel with coke in the cupola. By this means an increased sulphur content is

and 10 per cent. loss by oxidation and metal in the slag. During the six months' period under review, in which the total net output was 746 tons 53 per cent. of the steel castings and 77.5 per cent. of the iron castings were good; heads, gates and skulls accounted for 23.4 per cent. loss for steel castings and 15 per cent. for iron castings.

Articles on a locomotive which may conveniently be cast in steel amount to over 50 designs.

One of the advantages of the small converter is its flexibility, any grade of casting from dead soft electrical steel to high carbon material being readily made.

Steel Ingots.

Steel Ingots.—Table 5 shows a week's output of a 20-ton acid, hand-charged melting furnace, fourteen charges being cast of railway material for springs, tyres and sections.

Eleven to twelve heats per week are regularly obtained. The furnaces are gassed from old Wilson 4-cwt. producers modernised by the use of motor fan for air blast and exhaust steam taken from adjoining source. Eight gas producers in all fire the whole foundry, furnaces, annealing furnaces, core ovens, mould drying, five being allocated to the open hearths whose coal consumption for the week's output in Table 5 was 5.64 cwt. per ton of ingots. The half-yearly coal averages 7.89 cwt. per ton.

The furnaces are of the usual Siemens regenera-

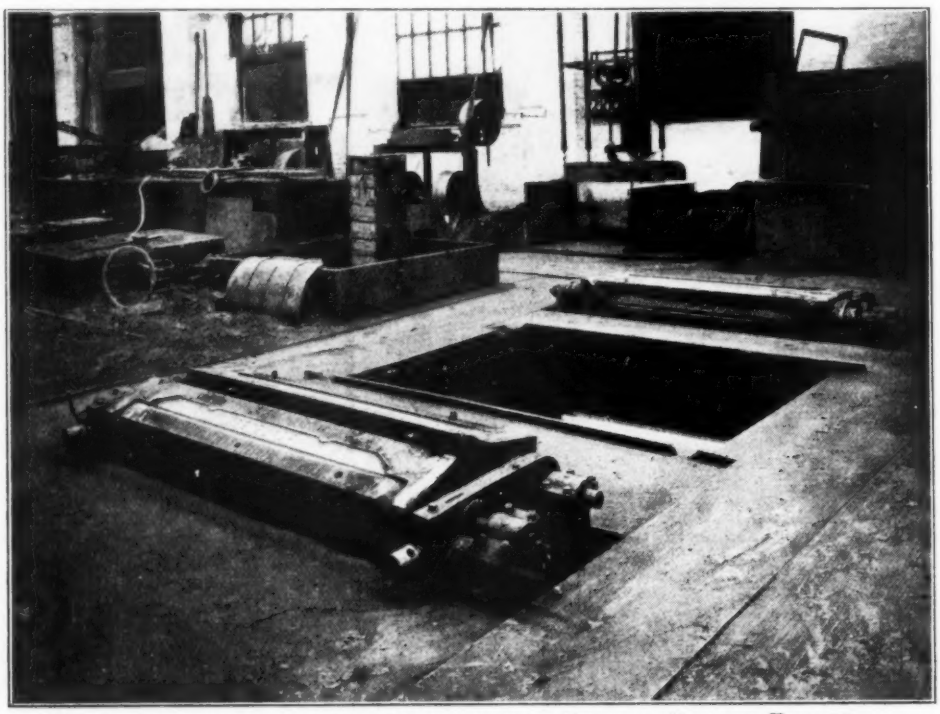


FIG. 7.—PERMANENT MOULDS FOR CASTING CHILLED FIREBARS, HORWICH FOUNDRY.

tive design, of which the chief characteristics are:—Size of hearth per ton, 9-10 sq. ft.; port areas, gas to air, ratio 330 : 850 sq. in.; regenerator chambers, free space in chequer work equal to ten times size of port areas; gas valve (Kirkham), 21 in. dia.; air valve (Butterfly), 30 in. dia.; chimney, 75 ft. (one furnace only), 1-in. draught.

To prevent short circuiting of air draught the usual air opening on top of the Butterfly valves is closed, and air is admitted to the flues through a second valve close to the furnace wall, and therefore well away from the suction of the chimney. This gives a keener pull on the hearth accordingly.

In addition to control of fuel and metal supplies in charge and yield, waste heat is graphically recorded by pyrometer of the Cambridge Scientific Instrument Company's make. This is found to be of great assistance in detecting warped valves, choked regenerators, leaking brickwork, and waste of fuel generally.

Annealing and Pyrometry.

To obtain the best results in toughness, uniform grain, and consequent life of a locomotive casting heat treatment is resorted to. Steel castings of ordinary design will comprise thick and thin sections, suddenly emerging one from the other in ways which the designer cannot entirely control. Such sections cast in a mould naturally undergo varying periods of cooling before all the heat is abstracted, and follow the laws of contraction by exerting corresponding "pulls" on those parts which are hottest and least able to withstand such treatment. To relieve them, thin webs of metal are left at these parts. The result is that, without distinct cleavage planes or fractures being actually present, a complex casting will contain within itself a series of strains, and these must be relieved and put into a state of ease before use.

Further, a casting having cooled down from a molten condition would naturally have its composite crystals in the coarsest possible condition, equivalent to the coarse fracture of an overheated or burnt steel. Such castings then would be in the worst condition to resist shock, and to obviate these effects they are annealed.

Annealing consists of reheating to a temperature sufficient to break up the existing structures as viewed microscopically, with subsequent slow cooling down. In all cases fractures of castings must show fine grain. The temperature to be utilised is a variable dependent upon the carbon content of the steel, whilst the duration of the anneal is regulated by the size of the casting. For locomotive castings, a temperature of 900-920 deg. C. gives the best results, gas-fired furnaces being used. The length of anneal varies considerably, small articles such as hinges and brackets, especially if of low carbon, are sufficiently annealed after eight hours' heating. For locomotive wheel centres, twelve hours' heating by gas at the temperature named, with further slow cooling, is found to give good results both in tests and service.

Broadly the main use for pyrometers is in the annealing of malleable and steel castings. Record charts can be produced for each batch of castings treated, and the chart acts as an incentive to the furnaceman.

For this purpose it is preferred to the simpler indicator type. For iron castings, pyrometers have not found a regular use beyond observations in the works laboratory for special investigation and in the foundry for optical measurements of ladle temperatures. The foundry is equipped with thermo-couple pyrometers of the wall type, and the continuous indicator design made by the Cambridge Scientific Instrument Company, which have given good results.

For portable work the Whipple resistance pyrometer and the Fery type are used. It is not within the scope of this address to go into detail, in view of the great amount of literature now available

Metal Moulds in the Foundry.

By S. A. E. Wells.

(*Continued from p.* 476.)

At the National Physical Laboratory, for the production of light alloy strips for rolling, a very successful method has been developed for the mechanical control of rate of pouring. It consists of the provision of a small V-shaped groove cut from top to bottom at one side of the strip mould. Fig. 1 illustrates a horizontal section through the mould with a sketch of the V-groove alongside. It must be borne in mind that the resulting V-shaped runner left on the edge of the strip is to be removed before any mechanical working. This runner would be unaffected by the early working and remain in the weak cast state, and therefore unable to accommodate itself to the extension of the strip as a whole. Serious cracking would result from omitting to remove the runner.

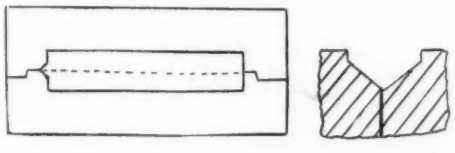


FIG. 1.—TYPE OF MOULD USED AT THE NATIONAL PHYSICAL LABORATORY.

The pourer's responsibility in employing the V-groove consists in keeping a steady stream flowing, which just keeps the groove filled to its maximum. Another most useful function of the V-groove is to assist in eliminating splashing. The size of the groove varies with the rate desired to be employed; for example, quite a small groove would be used for aluminium and its alloys, where the rate of pouring is very slow, and a considerably larger groove for brasses, where a faster rate is required. The abstraction of heat from the ingot by the mould is the next factor to consider.

The depth of chill imparted to the ingot depends upon the wall thickness of the mould and the temperature of the mould. All other factors being constant, the thicker the wall of the mould the greater will be the depth of chilling.

FIG. 2.—GRAIN GROWTH AS INFLUENCED BY LIGHT CHILL.

Two ingots of 70/30 brass were poured into hot sand moulds, the bottoms of which consisted of light and heavy chills, ½ in. and 1½ in. thick respectively. The lightly-chilled ingot developed a fairly coarse columnar grain growth, which merges into massive grains, while the heavily-chilled ingot has developed a much finer columnar grain, extending to about double the depth of that of the lightly-chilled ingot before merging into the massive grain growth at the centre. Figs. 2 and 3 show vertical sections of the two ingots, representing a total depth of 2 in. on the actual sections. The walls of the moulds were purposely constructed of sand, and made hot in order to keep down opposition grain growth.

Ingots demonstrating the effect of mould temperature were made in precisely the same manner to that for the "wall thickness" ingots, also using 70/30 brass. The ingots were cast upon 1½-in. chills, which were used cold, 300 and 500 deg. C. respectively. The effect of this temperature variation has been to diminish the depth of chill as the temperature rises. Figs. 4, 5, and 6 are vertical sections of the ingots, representing a total depth of 2 in. of the actual sections.

Mould Temperature Variations.

The effect of mould temperature variation upon the casting of small round billets of an aluminium alloy has been determined. A temperature range

FIG. 3.—GRAIN GROWTH AS INFLUENCED BY HEAVY CHILL.

extending from 150 to 500 deg. C., rising in steps of 50 deg. C., was investigated. Using a constant pouring temperature—namely, 700 deg. C.—and utilising a slow rate of pouring, employing a stream having a cross-sectional area of approximately 1-10th sq. in., a series of small billets were obtained, which, when suitably sectioned vertically and macro-etched, provided interesting results. Temperatures from 200 to 350 deg. C. appeared to give similar results, all being of a fine grain, with

FIG. 4.—INFLUENCE OF CHILL TEMPERATURE ON GRAIN GROWTH.

freedom from contraction cavities (Figs. 7 and 8). The billet produced from the mould standing at 150 deg. C. was generally coarser in grain, except for the surface layers in immediate contact with the mould, and had developed a central chain of

contraction cavities extending almost to the bottom of the billet. In this case the billet appears to have cooled too rapidly on the surface, leaving a molten centre, which had to contract substantially without a reasonable chance of feeding. The higher temperature moulds, 400-500 deg. C., produced billets having a much coarser grain, increasing in size with rising mould temperature, accompanied by a certain amount of contraction, forming cavities. Observation had shown that these billets had taken a considerably longer time to solidify than those mentioned above, so that

FIG. 5.—INFLUENCE OF CHILL ON GRAIN GROWTH.

the coarser gran was anticipated. It will be seen that what thickness of wall and temperature of mould to employ is largely a matter of experiment. So many sizes of ingots and classes of metals are dealt with, each requiring treatment to suit its own special case, that to lay down a definite rule is difficult. It is, however, worth noting that metals of the heavy classes with high melting points require lighter moulds, used at higher temperatures, than those of the light alloy classes when a comparatively heavy mould at a lower temperature is employed.

Mould Facings.

The facing of the mould is of the utmost importance, and should be carried out frequently. Dressings of graphite or plumbago and oil, lard oil, Russian tallow, beeswax, and ordinary domestic black-lead all have their special purposes.

FIG. 6.—INFLUENCE OF CHILL TEMPERATURE ON GRAIN GROWTH ALMOST DESTROYED.

Rate of Pouring.

In this class, moulds specially designed and constructed to cope with the extensive production of small parts and fittings of machines and instruments where accuracy and interchangeability are required are included. The various methods used are known as die-casting processes. A suitable die or mould is constructed of steel, and is so made that when the mould is opened the casting will either fall out or can be easily ejected. The design and construction of the dies constitute the vital factor in the successful operation of die-casting processes.

Choice of Dies.

Firstly, the choice of material is of utmost importance, as the number of castings that can be produced from a single set of dies varies with the properties of the steel from which the dies

FIG. 7.—CONTRACTION CAVITIES IN CENTRE OF INGOT. VERTICAL SECTION.

are made. Chrome-vanadium steel is most widely used, and 10,000 castings may be taken as a fair average yield for a properly constructed die of this material.

A die is usually a costly piece of plant to construct, which makes it essential to employ only very skilled labour for their production. A simple die may cost £20 to produce, while there is a demand for very complicated dies costing as much as £100. Dies should consist of as few partings as possible in order to avoid fins.

The chief difficulty in die design is the necessity for quickly removing the finished casting, and the designer is frequently compelled to resort to the use of loose parts and cores for the formation of projecting parts. As far as possible dies should be mechanically operated, so that the dies are opened and cores and castings removed in minimum time with lowest labour charges. Dies must be used

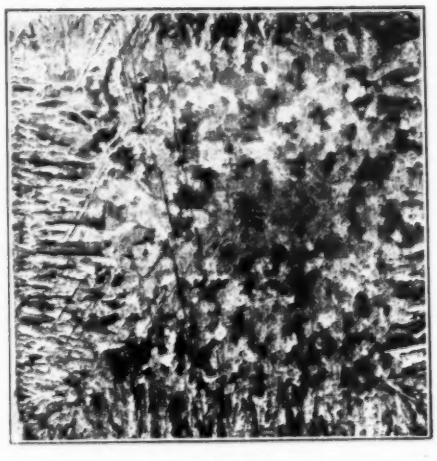


FIG. 8.—SHOWING VARIATION IN GRAIN SIZE FROM OUTSIDE TO CENTRE OF INGOT. VERTICAL SECTION.

at a constant temperature to prevent changes of dimensions being brought about through expansion of the die.

Venting.

Careful allowance must be made for shrinkage, and gates and vents carefully planned and located.

The gates need only be small, as the pressure employed ensures a rapid filling of the mould. The vents need only be of a very small area owing to the high pressure employed, although some arrangement of venting is essential. The spaces between the die faces, although serving to remove a portion of the trapped air, are insufficient to permit of a complete escape of all the air trapped.

Pressure Castings.

Pressure is applied by a number of means—either by a pump exerting pressure directly upon the metal, by air pressure upon the top of the molten metal, or by a head of molten metal. Casting is usually carried out in a machine, the principle of which is similar in all designs. The metal is melted in a lined metal crucible fixed inside a gas- or oil-heated furnace. Passing down into the molten metal is a tube of refractory material, which is connected at its upper end with a nozzle, through which the metal is forced into the mould.

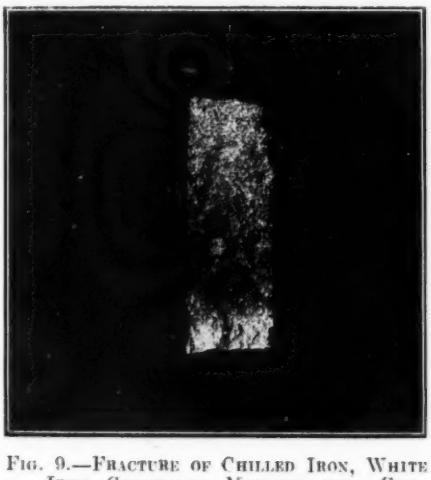


FIG. 9.—FRACTURE OF CHILLED IRON, WHITE IRON GRADUALLY MERGING INTO GREY IRON.

A sprue-cutting device is provided, by means of which the flow of metal is controlled at the nozzle. By raising the cutter the metal is allowed to flow through the nozzle into the mould, and by lowering the cutter, when the mould is filled, the flow of metal is arrested and the casting parted from the gate.

The application of air-pressure upon the surface of the molten metal is found to be the most successful method of forcing the metal into the die mould. The crucible is fitted with an air-tight cover, and connected through a control valve to a source of compressed air. By opening the valve pressure is applied to the molten metal, which, when the sprue-cutter is raised, forces the molten metal through the nozzle into all the interstices of the most complicated dies.

The dies, having been assembled and fixed to the machine over the nozzle, are carefully heated

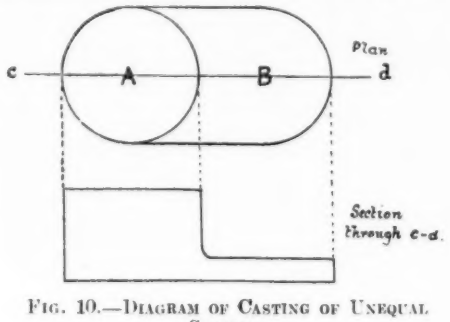
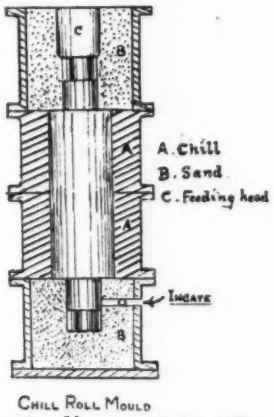


FIG. 10.—DIAGRAM OF CASTING OF UNEQUAL SECTION.

by means of an ordinary Bunsen burner. The temperature of the furnace is so adjusted that the metal is kept at a temperature a little above its melting point. Immediately the mould is filled, and almost without a pause, the die should be opened and the casting removed while still hot. The dies should be cleaned out occasionally and the surfaces dressed, after two or three operations, with beeswax, Russian tallow, or lard oil mixed with plumbago. This facilitates the extraction of the casting and also protects the surface of the mould.

The process in which mechanical pressure is employed directly upon the metal is particularly well suited to large castings of an open character, where freedom from blowholes and other irregularities, combined with a good finish, is desired. In this case the top and bottom of the mould are constructed as two separate units, with the top half containing the cores. The lower half of the mould is preheated to a suitable temperature and just sufficient metal for the finished casting poured in. The top half is then forced down into the bottom, making a metal-tight joint and forcing the metal into the interstices of the mould. This method is applied for the manufacture of crank-cases, gear-boxes, cylinders, etc., for motor-car and aeroplane engines.

Die castings can be produced accurate to within 1-1,000 in., including holes. Threads, both external and internal, of any desired pitch above 24 to the in., may be cast. Die-casting processes applied to repetition castings work out at much lower cost than any other existing method. Alloys for die-casting must be of fine, close grain, low in shrinkage, and the melting point should not exceed 650 deg. C. Alloys of lead, tin, antimony, zinc, and aluminium are usually employed, but a commercial success has been made of aluminium-bronze containing small percentages of iron.



CHILL ROLL MOULD

FIG. 11.—MOULD SET UP FOR CASTING SMALL CHILLED ROLL.

Chills.

There are two main reasons why chilling in sand or loam mould is practised. It is not, in these cases, the want of a permanent mould, but to produce one or other of two conditions: (*a*) The equalisation of the rate of cooling where castings are of varying section; (*b*) to produce a casting from one quality of metal having two distinct grades of properties in itself. The first condition can be applied to any metal or alloy which does not become "chilled" in the sense that certain grades of cast iron do when brought into contact with a metallic surface. Castings of unequal section tend to contract at different rates during cooling, and it follows that the portion most rapidly cooled completes its contraction first, the heavier portion, with a slower fall in temperature, continuing to contract after the lighter portion has ceased. This condition gives rise to stresses in castings, which increase as the differences in thickness of section are more pronounced.

Liquid contraction and shrinkage may be regarded as simple contraction only, and it may be reasonably assumed that castings in cooling contract towards their own centres when the casting is of equal section. A casting having a form similar to that shown in Fig. 10 obviously will have two independent centres of contraction. The light portion will cool rapidly, while the massive portion will cool slowly, so that the whole casting behaves rather like two distinct castings, the result being that the contraction is directed towards the centres A and B respectively of the two sections, produc-

ing a plane of weakness at the junction of the two sections, the metal drawing away from the junction. To produce the ideal conditions found in a casting of equal section it is therefore necessary to hasten the cooling of the heavier portion. To bring this about, a chill is inserted when ramming up the mould to form the lower surface of the heavy section, and so rapidly abstract the heat and hasten the cooling, thus equalising the rate of cooling throughout the casting. By this means the opposing forces are neutralised, and the plane of weakness at the junction of the two sections is eliminated by the merging of the two centres of contraction into one. Cast iron is mostly used for "chills," although brass and aluminium have been employed for certain classes of work. Comparatively light chills may achieve the object of equalising the rate of cooling, and the heavier the chill employed the more rapid will be the abstraction of heat. The use of chills requires that they be provided with some means by which they may be held in position in the mould, and for this purpose rods are usually cast into the backs of chills. Chills, when used for these purposes, must be free from rust and evenly coated with plumbago. The latter may be rubbed on dry or mixed with water and painted on, the chill being dried before use. The use of chills with green-sand moulds requires that the moulds are left open until ready to cast, as moisture from the mould tends to condense on the surface of the chill. Chills are usually inserted in the mould by bedding against the pattern and ramming up with the mould. Plane surfaces require only flat pieces of metal as chills, but curved surfaces require the preparation of chills of the desired curvature.

Variation of Properties by Chilling.

The production of castings from one quality of metal, having two grades of properties in itself, is limited to grades of cast iron which possess the property of "chilling." The effect of contact with a metallic surface is to produce an extremely hard surface upon a casting having a comparatively soft centre. Fig. 9 shows the effect of chilling on the fracture. The bottom shows the typical hard white-iron fracture passing gradually into soft grey, the hardness being determined by the condition of the carbon present. The sudden cooling of the surface has prevented the separation of the graphite, and the iron is thus left white by the carbon being retained in the combined condition. The thickness of the hard white surface layer is influenced by the temperature and thickness of the metallic chill and also the temperature of the molten metal. "Chilling" cast irons must have a low phosphorus content, and the silicon should be of the order of 1 per cent. Table 1. shows analyses of three samples of pig-iron suitable for chilling:—

TABLE 1.—*Typical Analyses of Chilling Irons.*

Cc.	0.84	0.50	0.60
Gr.	2.51	2.49	2.26
Si.	0.81	0.94	0.96
Mn.	0.66	0.72	0.60
P.	0.48	—	0.50

Chilled Rolls.

The chilling of cast iron is most extensively practised in the manufacture of rolls for rolling mills, which require to be externally chilled in order more successfully to resist wear by abrasion. Certain classes of car wheels are also chilled on the tread in order to provide a hard wearing surface. Fig. 11 shows a vertical section of a mould set up for casting a small roll. The mould is a composite one of sand or loam and metal, the metallic portion consisting of a cylinder or series of cylinders bored out to size, whilst the neck and coupling are moulded in sand. The roll is gated at the bottom, and the gate should be cut horizontally at a tangent in order to induce a rotary motion around the axis of the roll. By this means any sullage is concentrated in the centre, which assists in producing a clean surface to the roll. A feeder head is provided by extending the coupling. To conduct the heat away rapidly, and so give the required depth of chill, the area of the cross-section of the chills should at least equal the area of the cross-section of the hot metal in contact with them. The surface of the chills should be well coated with plumbago, and used dry and hot enough to prevent the condensation of water vapour.

Foundry Education.

By F. C. EDWARDS.

No one can deny that to follow contentedly, year in and year out, the occupation of an iron-moulder portrays the possession of a practical type of mind. Good physique is also a splendid asset in negotiating the more or less heavy manual labour that even the highest mechanical skill will never completely eliminate from foundry work.

The promising foundry apprentice, who is likely to develop into a steady, reliable workman, may be expected to be of a hardy nature, sanguine in temperament, and one who prefers doing things to thinking about them, with a mental bias towards the purely practical side of his craft, he naturally abhors the theoretical.

That this type of apprentice is generally encountered in the foundry, every-day experience amply confirms. The fact itself emphasises the necessity for the taking of special steps, in the interest of the employer, the employé, and the trade generally, to combat this natural aversion to study, and, by easy stages, to bring the *raison d'être* of foundry matters before the mind of the novice.

By whatever means this tuition is carried out, whether through the medium of works classes, public or private instruction, the initial stages should deal with the simplest facts of foundry work in the simplest manner. In this connection anything in the nature of cramming—which merely gives a parrot-like power of explaining, without understanding—cannot be too strongly deprecated; it is bound to defeat the object in view. Since the aim is to start the apprentice on the road of self-instruction, a little knowledge, thoroughly grasped and intelligently applied to actual daily work, in order to whet the appetite for more knowledge, is the sole *desideratum*.

The passing of set examinations—the bane of most educational systems—should be regarded as a secondary matter, or, better still, perhaps, altogether omitted. It is, indeed, a moot point whether in this case the orthodox tests are not more inimical than helpful to solid progress. The ultimate object is not to make professors, but to produce expert foundrymen.

Herbert Spencer's dictum that "education should proceed from the general to the particular," applies here with peculiar force. Technical definitions ought to be preceded by general notions. The statements of metallurgical facts should fall well within the compass of the apprentice's vocabulary, otherwise it simply will not be understood. Tangible proofs of natural laws affecting foundry work must be given wherever possible.

For example, the difference between the specific gravities of a sand core and molten metal, producing in the mould that upward hydrostatic pressure of the fluid metal which wrenches badly-secured cores from their moorings, and is thus a prolific source of scrap, may be illustrated by means of a cork in a vessel of water. To make the experiment more realistic and interesting, variously-shaped corks, or other buoyant material, resembling cores in daily use, could be introduced, and different methods of holding them in position, analogous to those in the case of actual cores, adopted where practicable.

Carried out by the apprentice himself, such experiments (in which the senses of sight and touch stimulate the reasoning faculty) are infinitely more instructive and enduring than any theory of densities worked out by mathematical formulæ. Hence, in all subsequent handling of cores, he cannot fail to visualise mentally the operation of the natural law, and is not likely to underestimate the lifting power of the fluid metal.

By methods adapted to each particular case, other salient points of foundry work could be similarly treated, always remembering that the assimilation and real grasp of facts is of more consequence than the mere ability to explain them. Foundry education, on these lines, is sure to excite the interest of the apprentice, and may eventually lead to the intensive study of his craft that differentiates the mediocre from the really expert workman.

XUM

James Bridge Steel Foundries.

The James Bridge Steel Works of Messrs. F. H. Lloyd and Co., Ltd., are the development of a business founded by the late Mr. F. H. Lloyd in 1879, when a foundry was put down on the present site for the production of high-class steel castings for the general engineering trade. The Works are situated in the Walsall Road, near Wednesbury, and about nine miles from Birmingham by the L. & N.W.R., whose Darlaston Station is immediately at the side of the works, so that transport facilities are exceptionally good.

The business was converted into a limited company under its present style in 1888, and its management is vested in Mr. John Hemming, Mr. D. C. Lloyd (son of the founder), and Mr Frank J. Hemming. During the succeeding ten years following the formation of the Company relatively little change was made in the Works layout, but subsequent to 1899 the whole works have been practically rebuilt, so that the existing layout is essentially modern in every detail. Altogether the Company owns some 120 acres of land.

The Works as we find them to-day consist of actually five foundries; of these three are devoted to the production of heavy castings, one to medium and light castings, and one to repetition work, the Works being capable of producing steel castings from a few ozs. up to 20 tons in weight. There is an excellent machine shop which undertakes, when required, the rough or finished machining of the castings.

The offices lie at the end of a drive which leads on to Walsall Road, upon which also there are two gateway entrances from the yard. The yard and shops are laid with a trolley track, enabling each department to serve the others. The railway sidings also serve the whole of the works, turntables being provided at the entrance of each shop, so that the railway wagons can be discharged at the most convenient part within the shop and the castings be loaded up by the shop cranes. The wagons for the No. 5 foundry and the new melting shop are hauled up the incline of 1 in 10 by an electrically-driven winch. There is a well-equipped laboratory, an analysis being made and records kept of all material used; an analysis is made of every cast, while tensile and elongation tests are also carried out.

The pattern shop is located immediately at the entrance of the Works, and occupies a building 100 ft. by 40 ft. It is lighted from both sides and

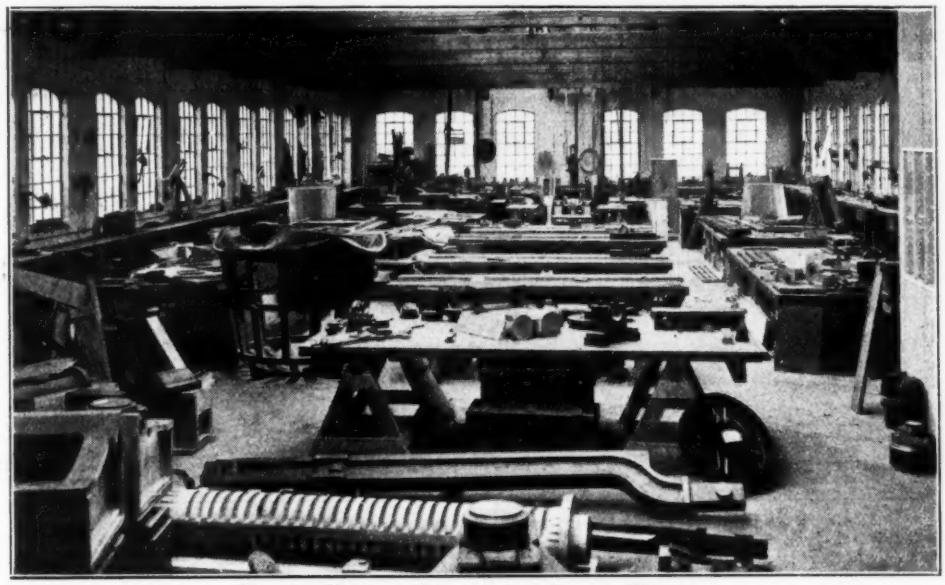


FIG. 1.—PATTERN SHOP; JAMES BRIDGE WORKS.

FIG. 2.—ONE OF THE HEAVY FOUNDRIES; JAMES BRIDGE WORKS.

also from the roof, and the floor is laid with concrete. The wood-working machines include two band-saws, two planing and surfacing machines, two lathes, and an Oliver sandpapering machine which is fitted with a dust-extracting apparatus. There is also a Mumert Dixon Co. tool grinder for hollow-grinding the tools. The line shafting for driving the machines is in the basement, and the belts are carried through the floor; in the basement also is the heating apparatus for warming the shop. There are three separate buildings for storage of the lighter patterns, a special department for receiving, checking and despatching, whilst the heavier patterns are stored in the yard.

FIG. 3.—ONE OF THE LIGHT FOUNDRIES; JAMES BRIDGE WORKS.

The No. 1 foundry, devoted to castings up to 5 cwts., occupies a building 320 ft. × 42 ft. and is served by four 5-ton cranes. The melting plant comprises two cupolas, which are served by an electric hoist and blown by Keith-Blackman motor-driven fans. The cupolas deliver to two 30-cwt. Tropenas converters, the molten metal being weighed as it is charged into them. In everyday practice these converters give from 6 to 12 heats in the 8 hours. The converter lining has a life of from 55 to 60 heats. It should be noted, however, that nothing but the best silica bricks are employed, no ganister whatever being used. The furnace for heating the alloys is coal-fired. Practically the whole of the work is hand moulded, three machines being used for sweeping up wheels or blanks of lighter weights.

The machine shop, covered by two bays 270 ft. × 34 ft. × 30 ft. wide respectively, joins on to the light foundry, the lower portion of the two bays serving to house the cutting-off tools, etc. The machine shop is served by a 20-ton, a 10-ton, and two 5-ton cranes. Amongst the machines installed mention may be made of a Stirk 84-in. vertical turning and boring mill, a Tangye horizontal milling machine, a Craven Bros. 39-in. lathe, Dean Smith & Grace 16-in. and 12-in. lathes, a Tangye 10-in. gap lathe with all-geared head, a Thos. Ward 30-in. chuck lathe, an 8-ft. faceplate lathe, a 13½-in. slotter, an Asquith radial drill, planers up to 14 ft. × 5 ft., and a group of small lathes by Barker and Wilson, and Dickinson. There is also a straightening press which was made in the shop.

FIG. 4.—PART VIEW OF MACHINE SHOP; JAMES BRIDGE WORKS.

The No. 2 foundry on the opposite side of the machine shop is devoted to heavy castings, and is covered by two bays each 250 ft. × 35 ft. The foundry bay is served by two 10-ton cranes and the fettling bay by a 5-ton crane. Three wheel-moulding machines are installed, and there are three drying stoves gas-fired by producer gas. The fettling shop has the usual complement of grinders and is circled by a compressed-air main for the pneumatic tools. For the time being the

metal for this foundry is melted in the furnaces installed in the No. 4 foundry.

The No. 4 and the No. 3 foundries are covered by a building 300 ft. × 50 ft. The melting plant in the repetition shop consists of two cupolas blown by Keith-Blackman fans and served by an electric hoist, which feed two 30-cwt. Tropenas converters. The shop is practically divided into two parts—the moulding portion and the casting floor. There are ten jolt ramming machines, the sand for which is raised by an elevator and fed to hoppers above each machine. The machines are placed five on either side of a steel-plate conveyor by which the moulds are travelled to the foundry floor, passing on their way through a tunnel drying stove which is heated by gas and assisted by the hot air from the coke-fired core oven placed immediately at the side of the tunnel. The portion of the floor devoted to fettling is served by a coal-fired annealing furnace, two Tilghman's sand-blast chambers and four emery grinders.

The No. 4 foundry, served by a 15-ton, a 10-ton, and a 5-ton Holt & Willetts cranes, is devoted to the production of heavy castings and forms at the same time the melting shop for the Nos. 2 and 5 foundries. The melting plant comprises two open-hearth furnaces, each of 8 tons capacity; of these one is worked basic and one acid, the average time for getting out a heat being eight hours. The charging platform is at truck level so that the railway wagons can be discharged direct on to the platform. The two stoves are gas-fired, a battery of five producers serving these as also the stoves in the No. 2 foundry. Fettling is done in a second bay 104 ft. long × 42 ft., the runways carrying a 10-ton Holt & Willetts crane. The annealing stove is coal-fired, and the tools include four cold saws and two emery grinders with a full range of pneumatic tools.

The No. 5 foundry, which is devoted to the heaviest castings, lies at right-angles to the No. 4, and is covered by a building 380 ft. × 53 ft., the floor being served by two 20-ton and one 15-ton Holt & Willetts cranes. There are four wheel-moulding machines upon which wheels up to any commercial diameter can be struck; in point of fact, a wheel 15 ft. in diameter × 16 in. on the face, weighing approximately 13 tons, was going through the foundry at the time of our representative's visit. The three drying stoves are gas-fired, taking gas from the battery of Morgan producers installed in the new melting shop. The foundry floor is on the higher level, and metal for casting is delivered by bogie from the furnaces to a well in the foundry floor and the ladle raised by one of the foundry cranes. The new melting shop, which is parallel with the No. 5 foundry, is 190 ft. long; the furnace bay, served by a 20-ton Royce crane which carries a 5-ton lifting magnet, is 62 ft. wide, and the producer bay 53 ft. wide. For the time being a 15-ton open-hearth furnace is being put down, but space is provided for a second similar furnace. There are three Morgan latest-type automatic producers, with the foundations in for two further producers. When the new melting plant has been put in commission for a few weeks it is anticipated that the two furnaces now in operation will be dismantled to make room for further extensions.

In 1917 the directors invited the employees to become shareholders in the Company, and at the present time they have an aggregate holding amounting to £12,000. So far as dividend is concerned, they rank as ordinary shareholders, though the directors personally guarantee a 5 per cent. dividend, whilst the men are allowed to withdraw their capital at any time. The Company also run a private savings bank paying an interest of 5 per cent. on all deposits.

An excellent club, with canteen, billiard room, recreation room, etc., has been provided by the Company, and this is in charge of a welfare superintendent who lives on the premises. Long service has always been suitably recognised, and around the dining-room walls one sees the photos of men who have completed not less than ten years in the service of the Company, with the record of service under the name, and it is interesting to note that there are men still with the Company whose records date back to 30 years.

FIG. 5.—NEW MELTING FURNACE IN COURSE OF ERECTION; JAMES BRIDGE WORKS.

There are cricket and football grounds, bowling green and tennis court, a capital pavilion, and also a number of allotments. As previously stated, the Company own the land, and this is lent rent free to the men, but for the rest the canteen and also the sports clubs are entirely self-supporting.

Manganese in Panama.—According to an official British report, an American concern has been operating on a small scale in two districts in the Republic of Panama—(1) at Mandinga Bay, in the Gulf of San Blas, and (2) in the Boqueron Valley. Recently, however, the amount of mineral mined has not been large. It is stated that the company propose to build a narrow-gauge line from the latter mines to the harbour of Nombre de Dios, a distance of from 10 to 12 miles.

Reduction of French Rail Rates.—The French Railway Companies are considering the question of lowering rates, especially in the case of heavy raw materials. The Minister of Public Works has provisionally approved a list of rates for metals, providing for a fairly large reduction of those actually obtaining. Rates for consignments of iron and steel products to French seaports are reduced by 25 to 40 per cent., and in the case of ores for export rates are reduced from 10 to 15 per cent.

Moulding Sands: Their Origin and Uses.

At a meeting of the Stoke Association of Engineers Dr. Alexander Scott, M.A., of the Central School of Science and Technology, Stoke-on-Trent, gave some interesting details of foundry sands.

After dealing at considerable length with the geological considerations affecting the origin and occurrence of sand, with special reference to the United Kingdom, the lecturer stated that various methods had been devised for determining the mineralogical constitution of sands, one of the chief of these being that whereby it was possible to determine what abnormal constituents were present in the sand.

Heavy Constituents of Sands.

The determination of the heavy residues was, in certain cases, of extraordinary value. It was found, for instance, that if one took a deposit of sand such as that obtained from Leighton Buzzard or King's Lynn, and examined the heavy residues from these sands, the result would be practically the same, whether the material were separated to-day, to-morrow or a year hence. This seemed to offer a valuable check and assurance that practically the same material was being supplied on one occasion as on another. In the determination of the constituent particles of these sands the lecturer used a method known as the Bromoform, which had never yet failed him in any serious test. Although the same suite of materials might be obtained from another deposit, the assemblage of any one deposit could be taken as characteristic. Into a vessel of the shape of a large glass was inserted a solution with a specific gravity between that of the ordinary minerals and that of the heavier minerals. All the light minerals would float, whilst the heavy minerals would sink. It was easy to devise some method whereby the two could be separated. Afterwards, by an ordinary microscopic examination, it was easy to ascertain quickly what the particular heavy minerals were, and therefore, whether the sand had come from the same quarry or the same bed as any other particular batch which had been supplied previously. Taking, for example, the Lower Greensands—a series of beds which ran in a north-east and south-west direction in the south-eastern quarter of England, embracing Aylesbury, King's Lynn and Leighton Buzzard—it would be seen that these always had a very characteristic suite of heavy minerals, such as kyanite, tourmaline and iron ores. These sands were largely quarried. The Bunter sands from the Birmingham, Mansfield, Worksop and Doncaster districts, however, are very short of these particular minerals. The Bromoform method would render possible a ready discrimination between the two types of sand, and it was a method of particular diagnostic value, especially if quantitative. By a determination of the heavy residues, the detection of the origin of the sand was comparatively easy and sure.

Light Constituents of Sands.

There were three main types of materials occurring in ordinary sands of lighter materials—quartz, felspar and mica. Of these, the quartz was incomparably the greater in quantity, but although the others were only present to the extent of from a fraction of 1 per cent. to 5, or at the most 15 per cent., they had a very strong influence on the properties of the sand. In the case of practically every sand the quartz deposited was in the form of angular grains. As the material was rolled along in Nature by water the grains became more rounded. Their shape, therefore, depended upon the amount of rolling which the material had sustained. It had been found that, for certain purposes, a sand with round grains was of special value, as in the case of the filtration of water, whilst for other purposes a sand with angular grains was essential, such as for mortar and abrasives.

The Role of Felspar.

Felspar only occurred in certain types of prominent sands. In the Bunter sands, for instance, felspar was an important constituent, there being sometimes as much as 15 per cent. of felspar present. The presence of this felspar had a marked effect upon the properties of the sand. A sand containing felspar would tend to reduce the melting point considerably, and therefore Bunter sands could not be used for steel castings, but were permissible for iron and brass. In certain sands, particularly those from the Glasgow district, the felspar had largely decomposed, which eliminated the difficulty of dealing with the alkalies, which were mainly responsible for the lowering of the refractoriness.

Mica.

The only other primary mineral which was of importance was mica, which occurred in many sands, and was generally an objectionable constituent; so much so, that if quantities were present it precluded their use for metallurgical purposes.

Bonding Material.

Fine-grained materials or bond surrounds the sand grains in the form of a very thin pellicle. It may consist of clay, quartz, limonite, glauconite or ferric oxide. In the Aylesbury sand it was a peculiar green silicate of iron and potassium, hence the name "greensand." In this case, however, the material is too fine for microscopic examination, but it is present to a considerable extent, and exercises an extraordinary influence on the properties of the sand. The two main points whereby this bonding material was rendered important were, first of all, its chemical nature, and secondly, its distribution. Its chemical nature determined its choice for strength of bond. In many of the sands iron occurred in the form of hydrated ferric oxide. This iron was derived as a breakdown from the ordinary iron silicates. It occurred as a very thin, impervious material, fine-grained, usually surrounding each particular grain of sand. This iron oxide was, in the ordinary way, of a colloidal nature, and consequently it was valuable as a bond. If ferric hydroxide were heated to a temperature of 300 to 600 deg. C., it lost its water, and if it were cooled down again and mixed up with water, it would re-absorb this water. This was important where a moulding sand had to be used over and over again. The hot material de-hydrated; if it could not be re-hydrated, then it could not be used over again. Where a material could be re-hydrated there was not so much tendency to "dead burning."

Where a sand grain was surrounded by clay a material resulted which was very fine-grained, which had a very large covering power, and which was, to some extent, plastic. It formed a bond similar to ferric hydroxide, but it had the disadvantage that once heated to a temperature of over 500 deg. C. the material broke down, after which one had to deal with a material consisting of free silica and free alumina. Of these two, the silica tended to hydrate readily; the alumina might, but it was rather doubtful.

In certain cases trouble might be experienced if the bond were not sufficiently refractory; in other words, the clay material might sinter. Wherever sintering went on one would have the material "dead burnt," and in that case there was little chance of the moulder being able to use it again. In certain cases it would be found, where the sand was not sufficiently plastic to make a good bond immediately after quarrying, if left to weather for some time, it would develop into quite a good bond. This was due to the breakdown of certain materials containing iron or, in other cases, felspar. Sands were sometimes weathered, in order to make them more plastic.

Grain Size.

It is essential that the bonding material should be very finely divided; if it were not, reversible hydration and de-hydration were impossible. The mere existence of the colloidal state did not, however, necessarily imply that the hydration and de-hydration were reversible.

The most important feature of bonding material was its distribution. If it were not uniformly distributed throughout the sand liability to trouble would occur. It was better that each grain should be coated merely with a very thin layer. If it

were not, there might be a segregation of bond in particular parts of the sand, leading to various troubles. One main reason was that quartz was very difficult to wet. If the quartz grains were surrounded by a very thin pellicle of some colloidal material, in that case the quartz could be wetted fairly easily, and the material as a whole would become plastic, or at least mouldable.

The Testing of Sands.

Mere analyses were of very little value unless some attempt were made to arrive at a useful interpretation of them. Mechanical means of arriving at analyses, such as lawning or sieving, only dealt with the relatively coarse materials; afterwards with the principle of elutriation, in which the carrying power of water was graduated by means of different velocities so as to carry over particles of determinable sizes. It had been found possible by this method to get a particular relationship between the grain size of the material and the velocity, and in this way it was possible to get fairly good approximations to the percentage composition of any particular sand.

Porosity.

The porosity of a moulding sand was very important, but it was unsafe to deduce from a percentage porosity the permeability of the sand. The porosity was important in the case of metals melting at low temperatures, and particularly if there were a certain amount of metallic vapour about, and this vapour had to be allowed to escape. If the surface of the mould were impermeable, the escape of metallic vapour might be inhibited, and blow-holes would result.

Refractoriness.

The composition of the sand had a certain effect upon the refractoriness. Of all the ordinary types of sand used in this country the high silica sands were the most refractory. The presence of alumina, whilst it might lower the softening point to a slight extent, was not very deleterious, but the presence of fluxing oxides, such as lime, magnesia, soda and potash, was extremely harmful, for these oxides tended to reduce considerably the refractoriness. In the case of the Bunter sands 0.3 per cent. of potash was sufficient to make them almost unusable for steel casting. For different types of castings materials were required of different refractoriness. In the case of brass and bronze the temperature was so low that practically any sands might do; for the casting of iron a considerably higher temperature was required, but most of the so-called moulding sands were useful; whilst for steel the temperature was so high—in the region of over 1,600 deg. C.—that a sand containing any large amount of fluxes could not be used.

The Washing of Sands.

In America the process of sand washing had been employed to a considerable extent. In most cases the sand, so treated, was not used for moulding or for structural purposes, but generally for glass making. In the case of moulding sand it was probable that washing might be objectionable, for the effect of it would be to remove the fine material. This loss of bonding power would certainly take away the main property of the material.

Metallurgical Consideration.

Different temperatures were required for the different metals, but, practically speaking, it was only in the case of steel that the refractoriness of the sand had to be taken into serious consideration, where the mould itself would be as high as 1,520 deg. C. In general, it would be found that there were three types of moulds in use. In the first place, there were greensand moulds—moulds that were used without any preliminary drying, generally employed only for rather small castings, owing to the difficulty of using them for large castings. Secondly, there were the dry sand moulds, in which case the moulds were pre-dried—the drying might be carried out in two ways: either heated in an oven or kiln to 300 or 400 deg. C., or, after the mould was made, or a skin might be put on to it by means of a blowpipe. Thirdly, there were what were termed loam moulds—by a loam mould was not meant a mould which necessarily contained any loam, but simply a mould that was made without patterns, which, to a certain extent, could be cut and carved about afterwards. For such moulds it was necessary to use materials with a very low contraction, and which were not very friable.

For moulding sands, with natural bonds it was sometimes useful to mix two particular kinds of sand, such as a strong sand containing a comparatively high proportion of clay material or ferric hydroxide, and a more highly siliceous sand, in order to improve the refractoriness.

Mould Powders.

There was also a fairly strong tendency in many districts to paint the surface of the mould with particular paints, such as very fine floured silica—crushed rock of a very marked degree of fineness. It seemed to him that there were rather serious objections to this practice. In the first place, the pores were filled up to a considerable extent, and consequently the permeability of the mould to gases might be considerably reduced. Secondly, trouble was almost sure to arise from the alteration of the silica on heating, for, when silica was heated, it underwent certain alterations; it changed over from a low temperature form to a high temperature form, and the latter had a very different specific gravity from the former, and in the transformation an enormous amount of shattering went on; instead of having low-grained quartz, one was left with high-grained silica, and consequently the porosity of the material was liable to be seriously impaired. The main troubles which occurred in the use of sands for moulding purposes were: the formation of "blow-holes," due to the volatilisation of the metals, the evolution of gases, etc. In many cases this might be due to the sand being packed too closely, so that its porosity was too low, and it was almost impossible for the gases to penetrate through the mould. In other cases it might be due to the use of tar or paint. There was one rather obscure cause which sometimes arose, and that was, that the fine clay which constituted the bond might tend to pass through the pores, and be carried to the surface, thereby blocking up the pore holes on the surface.

Troubles from Sands.

In steel moulding, what was called "burning on" was a common fault. This might be due to lack of refractoriness, to the fluxing of the sand, or to the breaking of the surface skin. Manganese steels were free from this, due to the formation of manganese silicate; but in the case of carbon steels, iron silicate might be formed to a slight extent. This would tend to adhere to the steel, forming scabs, whereas in the case of manganese steels, the manganese silicates had a greater tendency to adhere to the moulds, in which case there was much less likelihood of trouble.

Sand Specifications.

Regarding the actual requirements of a moulding sand, the first point to which attention had to be paid was the refractoriness; consequently, it was advisable to examine the composition of the sand in order to see that there was a high silica content. A low content of fluxing oxides was desirable, and a certain proportion of alumina or iron, or both together, was required for bonding power. The mechanical composition, in order to ensure a fairly high proportion of relatively coarse material, was important; there should be a very small proportion of the finer-grained constituents, a uniformity of grain of a particular size, and a lack of intermediate sizes. A fair proportion of the extremely fine material was necessary in the formation of a bond.

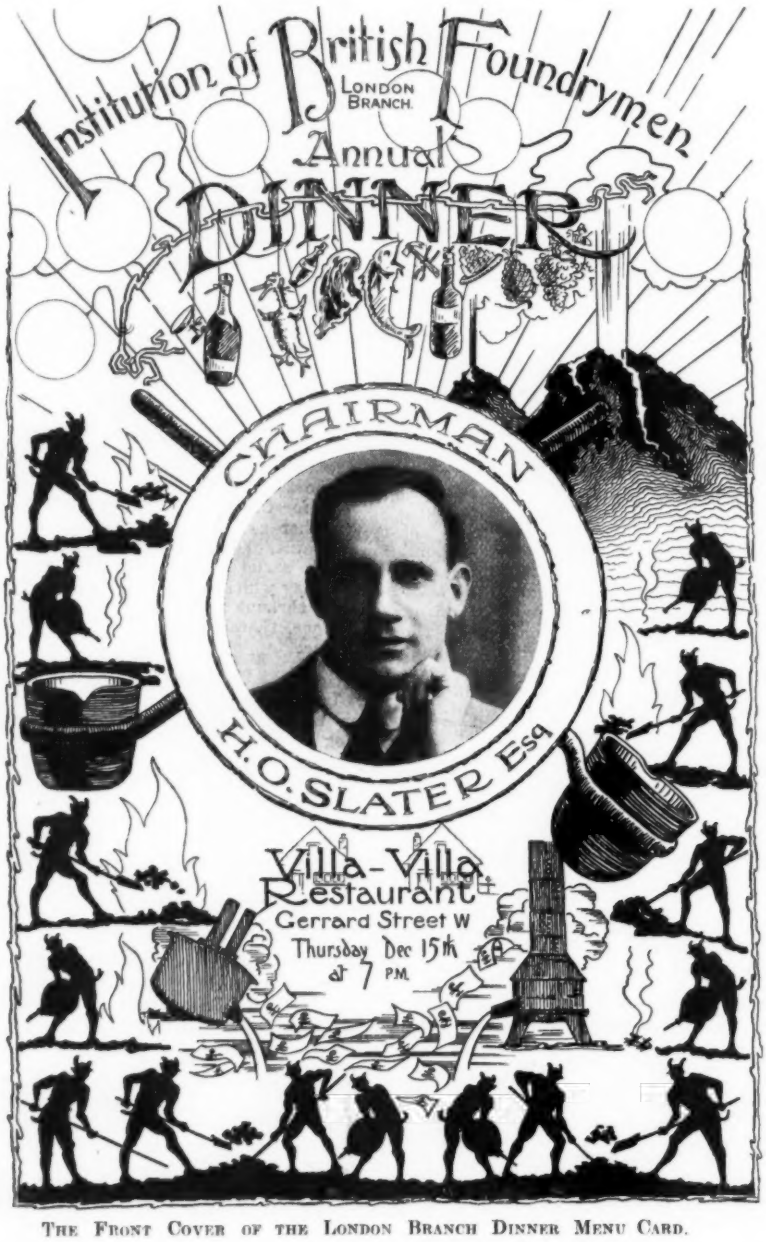
With regard to the distribution of the British sands, it was said that before the war we were very deficient in good sands. Thanks, however, to an investigation carried out by Prof. Boswell two or three years ago, it had been found that we have a relatively large stock of sands which are probably quite as suitable for foundry purposes as the Continental sands. There was one series of rocks in Anglesey, another in the north of Scotland, both of them providing sand of high silica content and of great utility. There were many other sand deposits of good refractoriness extending right down to the south-east of England.

Institution of British Foundrymen.

LONDON BRANCH.

Annual Dinner.

The first annual dinner of the London Branch held since the war took place at the Villa-Villa Restaurant, Gerrard Street, London, W., on December 15. Mr. H. O. Slater, Branch-President, was in the chair, and amongst those present were Mr. Oliver Stubbs (President of the I.B.F.), Mr. H. B. Weeks (Chairman of the Council of the British Cast Iron Research Association), Mr. J. E. Fletcher (Director of Research of B.C.I.R.A.), Mr. T. Vickers (Secretary and Organiser of the Association), Col. Cheesewright, D.S.O., T.D., Major D. Gordon, O.B.E., R.A.F., Mr. W. B. Blake, and Mr. J. S. G. Primrose.



THE FRONT COVER OF THE LONDON BRANCH DINNER MENU CARD.

The Loyal Toast having been duly honoured,

THE CHAIRMAN proposed the toast of "The President and Council of the I.B.F. and Our Guests." The Chairman first congratulated the members on the fact that they were honoured with the presence of Mr. Oliver Stubbs (President of the I.B.F.). Mr. Stubbs had taken a great personal interest in the London Branch. He had been present at the first meeting this session, and much of its success was due to his kind encouragement. He felt that if the London Branch had achieved nothing else it had made a very good start on the social side. He saw many faces that evening which were not often seen at the Branch meetings, and that evening's function should encourage them to mend their ways and help the Branch Council to pursue their work of raising the status of the foundry industry. The Branch was very deeply indebted to one of the recently-elected members of Council, Col. Cheesewright, for the interest he had displayed and the efforts he had made to ensure that the dinner would be a success. He hoped that the practice of holding social functions for the members of the Branch would grow. He extended a very hearty welcome to the guests that evening, and pointed out that if any were eligible to become members of the Institution in the very near future they would be welcomed by the members.

The toast was duly honoured.

MR. STUBBS responded to the toast, and, in doing so, he paid a tribute to the work which had been done by Col. Cheesewright. Speaking of the work which had to be carried out by the President of the I.B.F., he mentioned that he was in Birmingham the previous morning, in Manchester in the evening, and, after the dinner of the Lon-

don Branch that evening, he was leaving directly for Liverpool. As to the value of social functions in connection with their daily work, he believed that if everyone of them, as workpeople—he put that in the broad sense—would realise how much real pleasure they could get out of their every-day work, and out of each other's lives, and out of social functions of the kind they were attending that evening, they would accomplish better results in the industry than they had done in the past. It was a source of very great gratification to all engaged in the iron-founding industry to be able to meet each other as friends, whereas

AN APPEAL FOR SAFETY FIRST IN THE PIXIE'S FOUNDRY
MY HOBBY'S BEER
XXX
THE ORIGIN OF PNEUMATIC MELTING
DECIDING THE ORDER OF CHARGING
PUT & TAKE
PROPOUNDING A RIDDLE
THE WELFARE Dep.t
THE FOREMAN GIVES A FINISHING TOUCH
ARSENAL SCORES
WHO SAID GREEN SAND MOULDS?
SAND MIXING A POSER
THE CHARTER OF THE GOOD SHIP I·B·F.
INDUSTRY BEFORE FUN
THE LATTER TO-NIGHT
THE FORMER TO-MORROW
SEE TO IT.
TEEMING TIME A DEVIL OF A JOB

THE BACK OF THE MENU CARD.

in the old days they met as competitors. That was all important; they were advancing, and they would have to continue to advance in order to keep pace with competitors in other countries. Other people—he mainly referred to the French and the Americans—were more thorough in the work they did, and if the people of this country were going to bring the nation back to its old position they would have to give more solid thought to those details of the business which would allow us to enter the world's markets as competitors. He was pleased to be able to say that they had with them that evening Messrs. Weeks, Fletcher and Vickers, respectively Chairman of the Council, Director of Research, and Secretary of the British Cast Iron Association. It might be asked what relation did cast-iron research bear to the Institution of British Foundrymen? The Institution of British Foundrymen was formed with the idea of enabling the workman, *i.e.*, the man inside the foundry, to improve his position, his status. The British Cast Iron Research Association had come along to step in where the Institution's work finished, where it had finished with the everyday troubles in the foundry, and there was not the slightest need for any serious thought as to whether the Research Association was going to disturb the Institution. He had tackled the Executive in Birmingham the previous week, and asked how the Institution stood with the Association. The assuring answer he had received from Mr. Weeks had put him at rest; so that, if they had any troubles in their foundries which were just outside ordinary foundry practice, they should see to it that they supported the Association. They would then have a combination of the two bodies, the Institution working to solve the every-day problems in the foundry, and the Association tackling those

problems connected with the inherent properties of cast iron, oxygen, oxides, etc., on which subjects the Institution did not pretend to be authorities. The commercial aspect was obviously supreme, but it should be tempered with as much of the human element as possible, but the commercial element required information as to the use of high or low phosphorus, or sulphur, or anything else, what was to be the profit to them per cwt. when they sold the castings. Therefore, if the two bodies combined forces they would not go far wrong.

Referring to the Royal Charter of the Institution, Mr. Stubbs said that he himself did not claim a great deal in the obtaining of this, although, in the latter stages, when things were getting a little slow, he did step in. It was a very great achievement on the part of the Institution to have had a Royal Charter granted by the King and the Privy Council. It might not appear to be very much at first sight, but they could take it from him that there was a great deal in it, and a very great deal to be proud of. He was pleased to be able to say that the Institution was one of the few technical bodies to which a Charter had been granted and trusted that nothing they might do in the future would give those who had granted it any cause for regret.

He congratulated the London Branch on the work they were doing, and paid a tribute to the work done by Mr. V. C. Faulkner, the secretary of the Branch. It was gratifying to think that most of the members, after a day's work, had sufficient interest in their industry to attend the meetings, and carry forward such a splendid cause. He asked all those who attended the meetings to make a point of getting hold of another member who did not attend, and bringing him along. Let every man in the Branch feel that he was the man most responsible for carrying on the work. They would be pleased to hear that the Institution had been successful in forming a Branch covering the West Ridings of Yorkshire, embracing Bradford, Leeds, Halifax, Wakefield, Sowerby Bridge, and other places. In less than three weeks the membership had reached nearly 70. In conclusion, Mr. Stubbs wished the members a merry Christmas and a prosperous New Year, and urged them not to forget others in the industry who were facing hard times.

The next toast was that of "The London Branch of the I.B.F. and its President."

MAJOR D. GORDON, O.B.E., proposing the toast, referred to the Charter granted to the Institution, which he himself had brought up in the London Branch many years ago, but the bulk of the work had been done by Mr. Firth and Mr. Hayes, the late Secretary. He congratulated Mr. Slater on having been successful in organising a Branch Dinner, a thing which he himself had tried to do the previous year, during his own period of Presidency, but had failed. The evening had been most successful, and he hoped it would be the forerunner of many others. As to the President himself, he was a very old member of the Branch, and he hoped that his year of office would be a very successful one. He then referred to the medal which Mr. Stubbs had presented to the Institution, and emphasised the importance of doing everything possible for the younger members.

THE CHAIRMAN, responding, dealt first with the remarks of Mr. Stubbs, and assured him that there was a fair majority of sober-minded workmen in this country who were quite willing to co-operate with the employers with a view to bringing back the lost trade of our country. He felt that he must say a little on their behalf. Ever since he had joined the London Branch his chief aim had been to elevate the lower order of foundry life. They needed a little help, sympathy and guidance, even if some of them did not altogether understand the responsibilities of life.

MR. V. C. FAULKNER, who also responded, said that when it was pointed out that he ought to respond to that toast there was a little addendum made. It said that the toast would be responded to by Mr. Faulkner, who gave facts. Facts, he said, could either be pessimistic or optimistic, and he would start with the former. The London Branch was still in liquidation, but they had turned the corner, and the prospects were favourable. The London Branch was a very peculiar one, and he wanted other Branches to know that. If a full meeting were held, it would necessitate the members travelling 6,732 miles between them, an average of 42 miles per member. No other Branch could show anything like that, and the difficulties of organisation of a Branch of that nature he sometimes thought were insuperable. They were not, however, and the difficulties were being overcome. With the exception of the new Branch at Bradford, he believed, the London Branch had done as well as any other. He then went on to refer to the fact that there were several members who would have liked to have been present at the dinner, but, unfortunately, they were out of employment. These included some of their stalwarts, too, and it seemed hard that the Institution had no organisation with which to help them. There ought to be some such organisation. Coming back to the work of the Branch, the Council had backed him up excellently, but he wanted more backing from the members generally. Many members lived a long way away, and he had thought about holding meetings on Saturday afternoons. In Manchester this was carried out with great success. Further, he thought they might have two sessions, two days in the autumn and two days in the spring, reinforced by the Saturday meetings. At the last meeting, which was a joint meeting with the London Section of the Institute of Metals, practically every councillor was present, together with several persons whose nominations were being considered, but, beyond these, only four real members. One of those came from Peterborough, one from Swindon, and two from London itself. This must be changed.

MAJOR GORDON asked how many members were prevented from coming to the Branch dinner owing to unemployment.

MR. FAULKNER replied that there were four, including Members of Council.

MAJOR GORDON thereupon proposed to institute a fund for their assistance.

MR. H. B. WEEKS, at the invitation of the chairman, addressed the gathering. With regard to the apathy of the members, which had been referred to, he was sorry to hear that, because he was sure they would derive a great deal of benefit from the meetings in the discussion of practical workshop difficulties. With regard to the advance which was being made, and as predicted by Mr. Stubbs, they should start with the education of the younger members of the industry. At Barrow they had no less than 2,000 apprentices in their works (Messrs. Vickers, Ltd.). Ordinarily these apprentices were charged a premium of £5, which was returned at the end of their period of apprenticeship, if their services were satisfactory; also, of course, they received wages throughout apprenticeship. It was a fact, however, that they could not get a boy to go into any foundry as an apprentice if his father could afford to pay the £5 premium. Even if lads from other departments were given the opportunity to go into the foundry for their own benefit, they would shirk it if there were a possibility. The result was that they got the lowest class of boy as an apprentice in the foundry, and ceased their education for ever afterwards. In Barrow they were trying to improve matters, and, in conjunction with the local education authority, they arranged lectures for those lads; the lectures were pretty well attended. As a rule, the more intelligent boys, who were seeking more knowledge, were not found in the foundry. That state of affairs had to be altered, and it seemed that there was something for the Institution to do in that direction. If they could approach the education authorities, and work in conjunction with them, with the idea of educating those foundry boys, exactly in the same way as was done in other branches of engineering, they would be doing something which would put the industry on a different footing from that which it had hitherto enjoyed. Mr. Weeks congratulated the Institution for the part it had played in getting the Government to agree to the establishment of the British Cast Iron Research Association. When the Armistice was signed there was such an enormous demand for cast iron that the whole of the steel foundry and brass foundry at Barrow, as well as one of the biggest iron foundries in the country, had to be turned over to work on cast iron. There always would be a big demand

for cast iron. The Institution of British Foundrymen need not be jealous of their Research Association, because their functions were quite distinct. It was not research work to deal with ordinary foundry problems, the solution of which any foundry foreman should know, but there were a number of problems concerning the industry generally with which the Association would deal, with the idea of benefiting the industry as a whole. It would deal with the scientific side of the work, and undertake work which could not be undertaken economically by individual foundry owners. All those who were members would get the benefit of that research, and it must have an uplifting and beneficial effect on the whole industry. Finally he congratulated the Institution upon having obtained the Royal Charter, the importance of which he emphasised.

MR. W. H. ELLIS (a Past President of the I.B.F.) said he had been connected with the Institution from the beginning, and he paid a tribute to the splendid help and influence which THE FOUNDRY TRADE JOURNAL had given since the idea of forming the Institution was first discussed. He believed that had it not been for THE FOUNDRY TRADE JOURNAL there would have been no Foundrymen's Institution. There was no other means at that time of voicing their desires or of getting into communication with members. In order to encourage Mr. Faulkner with regard to the meetings of the London Branch, he mentioned that before the first meeting of the Institution, held in Birmingham, in connection with which 130 circular letters were sent out, there were only seven people present. They decided to go on, and letters were sent out stating that an Institution had been formed, and the result was that at the next meeting, held in Manchester, there were about 100 present. He could not help feeling proud, therefore, that they numbered about 1,600 at the present time. He referred to the work the Institution had done, and compared conditions before its formation with present-day conditions. At first, foundry work was not thought of in public schools and institutions, but that was not so to-day, partly due to the Institution of British Foundrymen; there was also the British Cast Iron Research Association, and there was no limit to the good work that could be done.

THE CHAIRMAN pointed out, in connection with Mr. Faulkner's statement as to the attendance at the last meeting, that there were between 80 and 100 present on that occasion, and that the meeting was a very successful and helpful one.

Through the kindness of Col. Cheesewright, D.S.O., a very fine musical programme was provided, which was much appreciated by the members.

At the conclusion of the function, subscriptions were made to a fund the purpose of which was to assist those members of the Institution who were unemployed, which realised £8.

Casein Glues.

Casein glues are as a class more water-resistant than animal and vegetable glues, but they are not, strictly speaking, waterproof. There is no glue that is waterproof in the sense that it is absolutely unaffected by water after a long immersion. Nevertheless, there are casein glues that are so water-resistant that plywood glued with them will withstand soaking for many weeks in water or exposure for many months to a warm, damp atmosphere. Under similar conditions animal and vegetable glues would soon lose their strength.

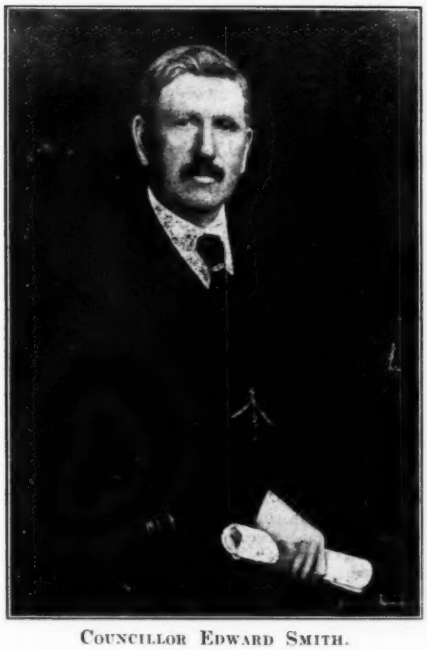
When casein glue joints are kept fairly dry they can be expected to retain their strength and remain unchanged for an indefinite period, as is the case with animal and vegetable glues. Water-resistant casein glue in a joint, kept constantly wet, will after a long time weaken, but it will ordinarily regain a great deal of its strength if the joint is dried. In a study aimed to discover the reason why casein glues ultimately decompose when kept moist, it was found that under certain conditions the decomposition seemed to be due to a hydrolysis of the casein, undoubtedly brought about by the sodium hydroxide always present in casein glues.

This explanation has been misunderstood to some extent, according to U.S. Forest Products Laboratory Technical Notes. It should not be taken to mean that casein glues are unreliable and not durable enough for use in manufacturing plywood and other glued products. On the contrary, casein glues are considered as permanent as any under dry conditions, and the water-resistant casein glues are more permanent than animal or vegetable glues under wet or damp conditions.—"Brass World."

NOTES FROM THE BRANCHES.

Newcastle Branch.

Councillor Edward Smith, Mayor of South Shields, is the immediate past-President of the Newcastle Branch of the Institution of British Foundrymen. Born in 1869, he was apprenticed to his father, a well-known iron and brass founder of South Shields. He succeeded his father in the business seventeen years ago. Five years afterwards he was joined in partnership by Mr. Joseph



COUNCILLOR EDWARD SMITH.

Smith, and a large modern foundry was added to the existing buildings, where marine turbine propellors and other large shipbuilding castings up to 20 tons in weight are made. Mr. Smith entered the town council in 1908, and this year gained the highest honour his townsmen can offer him by appointing him mayor of the borough. He has been an active member of the I.B.F. for many years, and has done sterling work for the Newcastle Branch.

Currency Transactions in Germany.—A Bill dealing with restrictions on currency transactions has been referred by the Reichstag to a Committee. The Bill prohibits dealing in foreign currencies (including cheques, bills of exchange, etc.) except through the Reichsbank and other authorised banks, who are required, before embarking on any such transactions, to take certain precautions in the case of persons not belonging to the banks' business connections. No obstacles will be placed in the way of employing foreign currencies in legitimate foreign trade.

Blast-Furnace Gas Cleaning.—During the last ten years the gas from the blast furnaces and producers at the Pont-à-Mousson Works has been cleaned by a dry process; improved in certain details by the Company's engineer. The method is to pass the gas through vertical wire screens suspended in frames; the dust is shaken from the screens by an up-and-down movement, and collects in a chamber below the frames. The gas, as it leaves the furnaces, contains about 6.5 grains of dust per cub. ft., but after passing the screens this is reduced to less than 0.5 grain per cub. ft. It is claimed that the temperature of the gas only falls about 30 deg. C. during the process. After cleaning, the gas is led direct to the hot-blast stoves and boilers.

Trade Talk.

THE FURNACES of the Islip Iron Company, Limited, have been put into blast again.

HOLLINGS & GUEST, LIMITED, Thimble Mill Lane, Birmingham, have recently appointed Mr. D. Landale Frew, of 45, Hope Street, Glasgow, as their sole agent for Scotland.

THE recently reconstructed Forth Shipbuilding & Engineering Company, Limited, will make a partial resumption of work at both Kelliebank and Jeffrey's Yards, Alloa, on January 4.

THE BROKEN HILL PROPRIETARY directors state that after the holidays only one blast-furnace will operate at the Newcastle (N.S.W.) steel works, the output, therefore, being reduced by two-thirds.

SOME of the chief amateur talent in science and engineering will be represented at the Small Power Engineering and Scientific Exhibition, which will be opened shortly at the Horticultural Hall, Westminster.

THE WORKS of John M. Henderson & Company, King's Works, Aberdeen, will be closed on December 30 and reopened on January 5, while the offices will be closed from December 31 to January 3 inclusive.

CLEVELAND BLAST FURNACEMEN, in order to revive the iron trade, have agreed that the sliding scale be suspended, and that from January 1 the district percentages payable on the base rates should be reduced from 77½ per cent. to 36 per cent.

THE contract for the supply of 40 miles of 54-in. pipes, required by the Manchester Corporation to bring water from Thirlmere to Middle Brook, near Horwich, has been secured by the British Mannesmann Tube Company, Limited, and the work will be carried out at the Newport (Mon.) works.

LICENCES HAVE BEEN GRANTED under the Non-Ferrous Metal Industry Act, 1918, to the Anglo-Continental Metals, Limited, 5, Bishopsgate, London, E.C.2; Jones, T. J., National Provincial Bank Buildings, Cowell Street, Llanelly; Nobel Industries, Limited, Nobel House, Buckingham Gate, London, S.W.1.

WITH REGARD to the proposal to alter the working day system in some of the North of England shipyards to an hourly basis instead of a datal one, a joint conference of employers and trade union representatives has been fixed to take place this week to go into the subject.. Meantime the employers' notices are suspended until January 25

CUMBERLAND IRON ORE MINERS have been notified by Messrs. W. W. Casson and J. Gavan Duffy, joint secretaries to the Board of Conciliation in the Cumberland iron ore trade, that the existing wage basis, equal to £7 per ton pig-iron, will continue until early in January, when the next pig-iron ascertainment is due. Large numbers of Cumberland iron ore miners are unemployed.

THE PIG-IRON SYNDICATE of Essen, which has been in existence in Germany for a period of ten years, has now been prolonged until the end of 1926 by the substitution for the existing agreement (which would have continued until the close of 1923) of a new agreement as from January 1, 1922, under which the basis of the tonnage allotments of the members has been completely changed.

OWING to the depressed condition of the shipbuilding industry, Messrs. Wm. Gray & Company, West Hartlepool, have suspended their profit-sharing scheme for the next two years, when the matter will again come up for consideration. Sir William Gray states there is little chance of any dividend being earned during the next few years. On the contrary, considerable losses may be incurred.

THE ANGLO-BRAZILIAN IRON AND STEEL SYNDICATE concession has been refused registration by the Tribunal of Accounts, principally because the fiscal favours extended exceeded the existing legislative authorisations. In November a decree was published authorising the grant of a concession to the syndicate. The decree conferred powers, and provided that a formal contract was to be signed in 30 days.

CONCERNING transactions in connection with Upper Silesian industries, it is reported that the Charlotten Hütte (or Herr Flick, the general director) has secured control over the Bismarck Ironworks Company, and a financial influence in the Cars-Hegenscheidt Company, and consequently a connection with the German Iron Trading Company, together with a considerable block of shares in the Kattowitz Mining Company.

WE UNDERSTAND that Messrs. Ransomes, Sims & Jefferies, Limited, of the Orwell Works, Ipswich, have just been appointed sole manufacturers and licensees in the United Kingdom, the Colonies and Dependencies, South America, Dutch Indies and China, for the patent Kestner water-tube boiler. This boiler has had a great success in France, where the highest economy is a *sine qua non* in steam generation. It is manufactured in that country by the well-known firm of Schneider & Cie., of Le Creusot, and is in use at many of the large municipal power stations.

RETURNS RECEIVED from shipbuilding yards and marine engineering shops show that the Clyde output of ships for this year was 314 vessels of all kinds launched, aggregating 514,549 tons, while the machinery constructed was equivalent to 568,791 horse power. This shows a substantial decrease on last year, when the tonnage was 569,960 and horse power 655,917.

THE RAILWAY RATES TRIBUNAL appointed under the Railways Act, 1921, has issued temporary directions to be followed in proceedings before the Tribunal. Firstly, anyone making an application to the Tribunal must make it in writing, setting out the facts shortly, and with exactitude, the relief which is asked. Secondly, the applicant must apply to the Tribunal through the secretary for directions as to how to proceed

A COURSE of lectures on "Foundry Practice" will be given at the Sir John Cass Technical Institute during the Lent and Summer Terms, 1922, by Mr. G. Patchin and Mr. A. F. Gibbs. The opening lecture of the course was given on Monday, January 2. A similar course on the "Mechanical Testing of Metals and Alloys" will be given by Mr. R. G. Batson on Thursday evenings, the first to take place on January 12.

THE following directors of the Lancashire and Yorkshire Railway Company will join the board of the London and North-Western Railway Company:—Mr. E. B. Fielden, Mr. J. H. Kaye, Sir Thomas Royden, Bart., M.P., Lieut.-Col. E. Wilfrid Stanyforth, Sir Edwin F. Stockton, Mr. G. R. T. Taylor, and Sir Joseph Watson. Mr. E. B. Fielden, chairman, will become the deputy-chairman of the London and North-Western Railway.

THE REPORT of the Humphrey Pump Company, Limited, for the year to September 30, 1921, states that the Dudley Port works buildings, held on quarterly tenancy, have been disposed of. A portion of the plant and tools and stock has been sold, and the remainder, owing to the heavy fall in prices, has been written down to what is considered are their realisable values. The accounts show a debit balance for the year of £2,397, making a net debit balance of £52,570.

WM. BAIRD & COMPANY, LIMITED, draw attention to the fact that several instances have recently come under their notice where "Gartsherrie" and "Eglinton" foundry pig-iron have been offered for sale in Great Britain and from the Continent under circumstances which leave no doubt in their minds that an attempt is being made to dispose of foundry pig-iron manufactured on the Continent under the name of their well-known brands. They propose to take the first opportunity which may offer itself to expose any case of the kind.

THE ANNUAL MEETING of the Sheffield Association of Metallurgists and Metallurgical Chemists will be held on January 10, when a smoking concert will follow the presidential address. The following gentlemen have been nominated as office-bearers for 1922:—President, Mr. T. Baker; vice-president, Mr. C. T. Nesbitt; hon. treasurer, Mr. L. Dufty; hon. librarian, Mr. G. B. Willey; hon. secretary, Mr. J. Evans; council, Mr. G. R. Bolsover, Mr. T. P. Colclough, Mr. J. H. S. Dickenson, Mr. J. H. G. Monypenny, Engr. Capt H. B. Moorshead, and Mr. H. Rollin.

THE following associations and firms have lately become members of the Federation of British Industries:—T. Sheldon & Company, Limited, Springvale Foundry, near Wolverhampton; A. G. Thornton, Limited, Paragon Works, King Street West, Manchester; Effingham Steel Works and Rolling Mills Company, Limited, Washford Road and Windsor Street, Sheffield; Lambourne & Company, Limited, Victoria Steel Works, Openshaw, Manchester; the Lea Recorder Company, Limited, 28, Deansgate, Manchester; Fletcher Malleable Foundries, Limited, Litchurch Lane, Derby; Blackburn, Starling & Company, Limited, Gresham Works, London Road, Nottingham; and F. W. Scott, Atlas Wire Ropes, Reddish, Stockport.

Deaths.

MR. J. GRIFFITHS, whose death is announced, had for 55 years been associated with the business of Henry R. Merton & Company, Limited.

MR. J. RUSSELL, manager of the Copper Miners' Tinplate Works, Cwmavon, died recently. Mr. Russell, who was 65, went over from the Old English Copper Company on the formation of the Copper Miners' Works over 40 years ago, and gradually rose until for over 12 years he occupied the position of secretary to the company. Two years ago, on the death of Mr. Lewis, the then manager, he was appointed as his successor.

Company News.

W. & T. Avery, Limited.—Interim ordinary dividend, 5 per cent.

British Engineering Units, Limited.—Capital £1,000 in £1 shares.

Hughes-Johnson Stampings, Limited.—Dividend, 7½ per cent., free of tax.

Steel Company of Canada, Limited.—Dividend, 1¾ per cent. on common stock.

Ferranti, Limited.—Preference dividend, 18 per cent., less tax, on account of arrears.

Hall & Company, Croydon, Limited.—Interim ordinary dividend, 1s. per share, less tax.

City Castings Company, Limited.—Capital £5,000 in £1 shares. Registered office: George Street, Coventry.

Cubitts' Engineering Company, Limited. — Loss, £63,609; plus preference dividend to June 30, 1920, £15,749.

Agricultural & General Engineers, Limited.—Interim dividend on first and second cumulative preference shares passed.

G. F. Barker & Sons (Brozen Foundry), Limited. — Capital £2,500 in £1 shares. Registered office: Newdigate Road.

Foundry and Machine Company, Limited.—Capital £20,000 in £1 shares. Registered office: 10a, Old Town, Clapham, S.W.

Cams, Limited.—Capital £60,000 in £1 shares. Engineers. Director: F. Cam. Registered office: 53, St. Mary's Road, Sheffield.

Metals Productions, Limited.—Capital £50,000 in £1 shares. Secretary: H. C. Hankins. Registered office: 62, London Wall, E.C

B.P. Engineering Company, Limited. — Capital £2.500 in £1 shares (1,000 7½ cum. pref.). Registered office: 6, Dalling Road, Hammersmith, W.6.

George Mitchell & Sons, Limited.—Capital £5,000 in £1 shares, to carry into effect an agreement with George Mitchell, ironfounder, Bonnybridge. Registered office: Bonnymuir Foundry, Bonnybridge.

R. Hood, Haggie & Son, Limited.—Brought forward, £61,597; profit, £82,176; ordinary dividend, 10 per cent., free of tax, for year; written off capital expenditure on buildings and machinery, £5,000; carried forward, £49,176.

H. Robinson (Birmingham), Limited.—Capital £1,000 in £1 shares, to acquire the business carried on at 27, Lionel Street, Birmingham, as H. Robinson, and to carry on the business of manufacturers of fenders and kerbs, ironfounders, etc. Registered office: 27, Lionel Street, Birmingham.

Light Castings, Limited.—Capital, £1,000,000 in £1 shares (400,000 preference and 800,000 ordinary), to acquire and amalgamate the businesses of M'Dowall Steven & Company, Limited, M. Cockburn & Company, Limited, Planet Foundry Company, Limited, and the Coalbrookdale Company, Limited. Directors: F. W. Monks, J.P., A. W. Steven, M. Cockburn, A. K. Steven, W. S. Malcolm, A. Wallace and J. Learmouth. Registered office: 7, Norfolk Street, Manchester.

Gazette.

A RECEIVING ORDER has been made against Mr. J. Heap, engineer, 153, Duckworth Street, Darwen, Lancs.

THE SUMMERFORD CASTINGS COMPANY, Summer Street, Willenhall, are paying a first and final dividend of 7d. in the £ on January 5.

THE CAMDEN METAL WORKS, LIMITED, are being wound up voluntarily. Mr. J. C. Wrist, Hayes, Middlesex, has been appointed liquidator.

A PETITION for the winding up of the Powerite Steam Jointing Company, Limited, will be heard at the Royal Courts of Justice, Strand, London, W.C., on January 17.

MESSRS. E. DURDEN, G. W. THOMPSON and A. S. ALLFORD, electrical engineers, 13, Queen Street, Liverpool, trading under the style of E. Durden & Company, have dissolved partnership.

MR. J. H. HOPKINS, formerly trading as the Electrical Maintenance Company, 57, Castellaine Mansions, Maida Vale, and lately carrying on business at 140, Wardour Street, London, has been adjudged bankrupt.

THE PARTNERSHIP heretofore subsisting between Messrs. J. W. Hill and H. Wilks, trading as J. W. Hill & Company, Silver Cross Street, Dewsbury Road, Leeds, brassfounders, has been dissolved. Debts by H. Wilks, who continues the business.

TRADING UNDER THE STYLE of the Vulcan Pattern Making Company, Messrs. A. Towle, W. G. Francis and H. Mote, Carlton Works, 132a, Much Park Street, Coventry, engineers' pattern makers, have dissolved partnership. Debts by A. Towle and W. G. Francis, who continue the business.

Publications Received.

"Fume Condensing and Dust Collecting." A. E. Harris, engineer, 71, Finsbury Pavement, London, E.C.2.

"Converting a Business into a Private Company," by Herbert W. Jordan. 1s. net. London: Jordan & Sons, Limited, Chancery Lane, W.C.2.

THE INDUSTRIAL LEAGUE AND COUNCIL JOURNAL, December, 1921, price 3d. The Industrial League and Council: Offices, 82, Victoria Street, London, W.C.1.

"Universal Exchange and Interest Tables," by A. J. Lawson, M.Inst.C.E. 15s. net. London: Thomas Skinner & Company, Gresham House, Old Broad Street, E.C.2.

"The Foreign Exchanges and How to Profit by Them," by Victor Louis Gerard. The Pall Mall Industrial Investments, Limited. London: Trafalgar House, Waterloo Place, Pall Mall.

AUTOMATIC CENTRIFUGAL CLUTCHES TO ENSURE EASY STARTING OF ANY TYPE OF MOTOR UNDER FULL LOAD. Thos. Broadbent & Sons, Limited, Central Ironworks, Huddersfield.

CONSETT IRON COMPANY, LIMITED, CONSETT, CO. DURHAM. "SIEMENS OPEN-HEARTH AND MILD STEEL." This useful little book contains much information relative to the varied manufactures of the company. Analyses are given of "Bute" and "Delves" firebricks, pig-iron. The book abounds in useful conversion tables for such diverse calculations as the relation of volume to weight of benzole to the conversion of "tons per square inch" to "kilograms per square centimetre." All the standard tests for strip and boiler materials are included. It is the type of book which is more likely to be worn out than lost, as it is a real time-saver for both engineers and metallurgists.

Personal.

THE late Mr. W. H. Walker, coalowner, of Cardarroc House, Chapelhall, left £47,811.

MR. E. W. PETTER, chairman of the British Engineers' Association, is shortly going to India.

THE late Sir Charles Douglas Fox, J.P., the well-known civil and mechanical engineer, left £45,766.

THE late Mr. G. Lowe, of Downall Green, North Ashton, near Wigan, hinge and lock manufacturer, left £1,305.

THE late Mr. W. R. Phillips, formerly manager for Messrs. John England & Company, engineers, of Hatcham, Luton, left £11,378.

MR. W. THOMAS, engineering manager at the Mansel Tinplate Works, Port Talbot, has been elected a trustee of the Victoria Institute of Port Talbot.

MR. T. G. BELL, a director of the Glamorgan Wagon Company, Limited, has resigned, and has been succeeded by Mr. S. H. Lewis, of Llandaff, Cardiff.

SIR GEORGE CARTER, managing director of Cammell, Laird & Company, Limited, Birkenhead, is lying critically ill at Brettanby Manor, Bartmen, Yorkshire.

MR. D. J. DAVIES, late agent and manager of the Tirdonkin Merthyr Collieries, Limited, has been the recipient of a presentation from the officials and office staff of the company. Mr. Davies has been appointed agent and manager at the New Glynea Colliery, Llanelly.

MR. LINCOLN CHANDLER has resigned his managing directorship of the Metropolitan Carriage, Wagon and Finance Company, Limited, but remains on the board of Vickers, Limited, the Metropolitan-Vickers Electrical Company, Limited, and W. T. Glover & Company, Limited. Mr. Bernard Docker, the son of Mr. Dudley Docker, has been nominated by Vickers, Limited, to the Metropolitan Company's board. Mr. Hodgkinson, an old member of the Metropolitan board, is retiring at the ripe age of over 80. Mr. H. J. Morriss, who has been in the service of Vickers, Limited, and its predecessors, ever since he was a boy, and who was elected to a seat on the board in 1919, is resigning his managerial duties as from the end of the year in order to take a rest. He remains, however, on the board.

Co-partnership in Czecho-Slovakia.—The Czecho-Slovak Ministry of Justice is drafting a Bill providing for the participation of employees in industrial undertakings. The underlying principle is that, by remitting a certain part of their salaries or wages, the employees and workmen become co-partners in the concern in proportion to their holdings, without, however, being given a voice in the management.

IRON AND STEEL MARKETS.

Pig-iron.

The closing markets of the old year disclosed few indications of change in the general position of the iron trade, the altogether inadequate concessions by the railway companies in the transport charges having so far had little effect in stimulating active buying, which it is considered probable may be delayed until iron-masters have had an opportunity of considering the question of a further downward revision of prices. Extreme disappointment, however, is expressed in Scottish trade circles at the decision of the northern railway companies not to fall into line with the English to grant a reduction in rates for conveyance of iron and steel material, which will, it is feared, inflict considerable hardship upon consumers and producers alike. It had been generally expected that a reduction similar to that conceded by the southern lines would be extended to the Scottish firms, who contend, with justice, that the railway authorities are by no means contributing their share towards a possible revival of trade. At present business in Clydeside is suspended for the New Year holidays, which, on this occasion will be prolonged over the week, the opportunity being generally utilised for a general overhauling of plants, and the work of necessary repairs to furnaces, etc. In South Staffordshire there has been so little business passing in pig-iron that values have had no very definite basis. Some Derbyshire houses were still quoting 97s. 6d. for No. 3 foundry and 87s. 6d. for forge. The Cleveland iron market opened the New Year in a rather more hopeful mood, and although business so far has been on a restricted scale signs are not lacking of a return to more active conditions in the near future. At this week's market there has been more inquiry from Scotland for Cleveland foundry iron over the first quarter of next year, but there is some difference of opinion as to price. However, the whole range of Cleveland iron prices is likely to undergo review this week, and if it be found possible to make another cut business is likely to show considerable expansion with beneficial effects on local industry. Meanwhile prices are unchanged at the following bids :—No. 1 Cleveland 105s., No. 3 Cleveland G.M.B. 100s., No. 4 foundry 95s., No. 4 forge 90s., mottled and white, 85s.

Some improvement in buying of East Coast hematite is noted, consumers from a wide range having been attracted by the low quotations of the East Coast makers, and there have been further shipments to South Wales. In this branch of the trade it is reported that the output is now being fully taken up, and the possibility of more furnaces being put into operation is not remote. Quotations continue steady at 100s. East Coast mixed hematite, with 2s. 6d. extra for No. 1. So far as North Lancashire and South Cumberland are concerned the production of hematite has sunk to a very low level, for there is only one furnace blowing, and that is at Ulverston. At Barrow the two furnaces were damped down for the holidays, and according to present arrangements will be in operation again on January 9.

Ore.

The year just closed will be memorable in the foreign ore trade as possibly the worst ever experienced in its history, the slump in the iron smelting industry, and the enormous amount of battlefield scrap going into the furnaces being contributory causes. Of late, however, business in South Wales has shown a considerable improvement, and it is to be hoped that movements in the North will also open out before the New Year is very old. In the meantime best Bilbao rubio is quoted more or less nominally at round about 27s. per ton, c.i.f. Tees.

Steel.

The reopening this week of markets for steel material has so far produced few fresh developments bearing upon the general position of the trade, which unfortunately remains in its previous quiet condition. In the Sheffield district most of the works are taking an extended holiday, but it is stated that a number of open-hearth steel furnaces will be re-started, probably next month, a satisfactory item of neys in view of the slackness of this section for so many months past. The crucible steel trades are still badly placed, and the consumption of alloys and high-speed and similar steels is at a minimum. In some directions, however, ordinary carbon tool steels are providing a certain amount of work. Crucible manufacturers, however, do not anticipate any big improvement until they hear that there is a brisk movement in the heavy trades, and a rush to put blast and Siemens furnaces into operation. Makers of farm and garden tools and appliances complain of a lack of seasonal orders, although prices of these manufactures were reduced last year, the usual spring trade with Ireland being held up on the strength of buyers' hopes of a further cut in prices.

In the finished material section of the trade at Manchester, there is certainly further weakness so far as sectional steel is concerned, and lower prices are being taken for plates, angles and joists. Some regularisation of these prices may probably come early in the new year.

Finished Iron.

With the majority of manufacturers of finished iron occupied with stock-taking or idle from lack of orders, the outlook in the trade is somewhat obscure at the moment pending the result of the recent decrease in rail transport rates and the absence of a strong inquiry. Stocks of finished materials in merchants' hands are, however, surmised to be at a very low average, prospective purchasers having deferred placing orders in the expectation of a further reduction in prices, and replenishment should therefore provide a certain amount of business at an early date. Work at the mills in the South Staffordshire area has been partially resumed this week, makers of high-grade bars having a few unexecuted orders to start upon, but reports do not suggest that much new business has been coming into the common bar mills. These have been working short time for months back, and the Association basis of £13 is a purely nominal figure. Iron strip at £13 10s. is also a poor market, tube makers showing preference for steel strip wherever it is applicable. This, it is reported, can be bought well under £11.

Scrap.

Business in the scrap metal trade remains so far unchanged from previous conditions, nor is any improvement probable until work is resumed, Cleveland prices meanwhile stand as follow :—Heavy steel scrap, 57s. 6d. to 58s. 6d.; steel turnings, 37s. 6d.; c.i. borings (purely nominal), 38s. to 40s.; heavy cast-iron machinery scrap, 80s.; bushelling scrap, 52s. 6d. to 55s.; heavy wrought-iron piling scrap, 55s. to 60s. All delivered works.

Metals.

Copper.—The final metal markets of the old year, limited to three days only, were not remarkable for the amount of business passing, buyers and sellers alike reserving dealings until the holidays were over, while price fluctuations were unimportant on the whole. Members of the copper section are for the moment more concerned with the future possibilities than present-time realities, the former to a large extent being governed by the attitude of the American market. A favourable feature in the last-named element is the encouraging development in the American exchange, now well on the way to par, and this, combined with a revival of consumptive demand, should have a good effect on the home market for the metal. Closing prices:—Cash: Wednesday, £66 5s.; Thursday, £66 2s. 6d.; Friday, £66 2s. 6d.; Monday, ——; Tuesday, £65 17s. 6d. Three months: Wednesday, £67 5s.; Thursday, £67 2s. 6d.; Friday, £67 2s. 6d.; Monday, ——; Tuesday, £66 15s.

Tin. — The market for tin maintains its strength fairly well, though values have occasionally shown slight variations, the reaction being explained by operators' profit-taking realisations. The outlook, however, is regarded as favourable to expansion of business in the near future, due to the activity in the Welsh tinplate trade, and a better scale of buying on account of American interests. Eastern advices also show a firmer tendency in prices generally, any setback being utilised for fairly good purchasing at the lower levels. The concluding market for 1921 showed some strength in the forward position, with prompt sales on a more restricted scale. Closing prices: Cash: Wednesday, £172 5s.; Thursday, £170 15s.; Friday, £170 10s.; Monday, ——; Tuesday, £168 12s. 6d. Three months: Wednesday, £174 5s.; Thursday, £172 15s.; Friday, £172 10s.; Monday, ——; Tuesday, £170 10s.

Spelter. — Conditions in the spelter market of late have developed some irregularity, with prices on the whole showing a weakening tendency, and business done has been mostly of a hand-to-mouth character. Closing prices:—Wednesday, £27 10s.; Thursday, £27 7s. 6d.; Friday, £27 10s.; Monday, ——; Tuesday, £27 10s.

Lead.—In the market for soft foreign pig there has been a sharp set-back in prices, due in the main to a slackening of demand, coinciding with the fact that a fair tonnage of December metal came rather unexpectedly on the market. English closing prices:—Wednesday, £26; Thursday, £25 15s.; Friday, £26; Monday, ——; Tuesday, £26.